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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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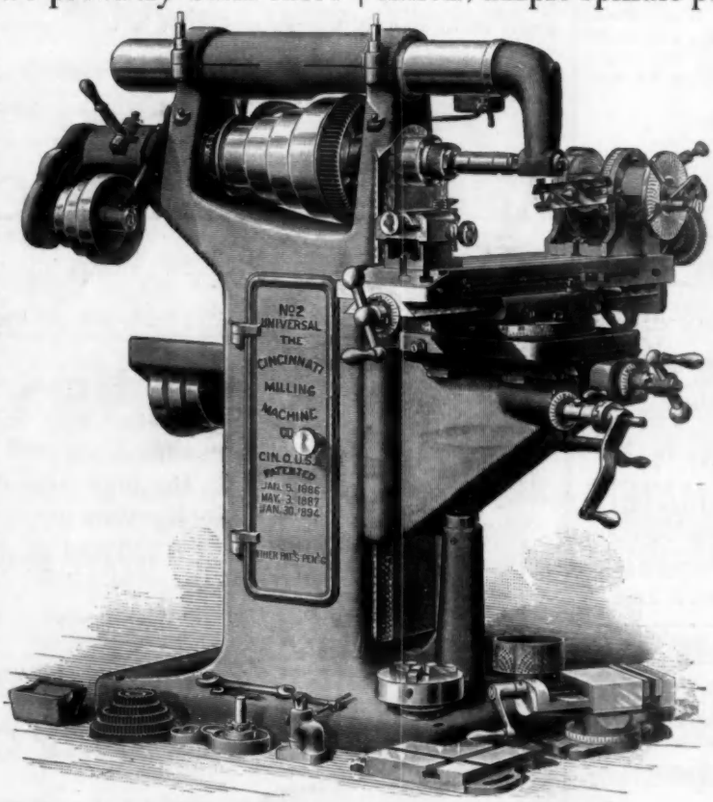

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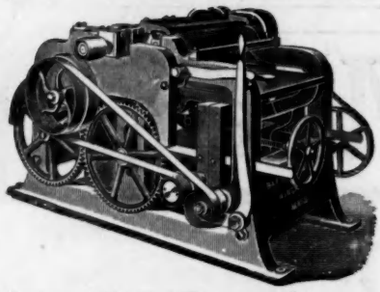

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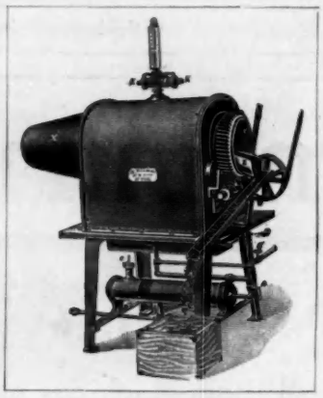

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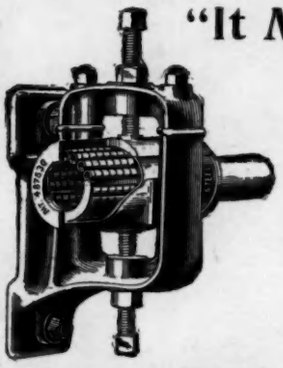

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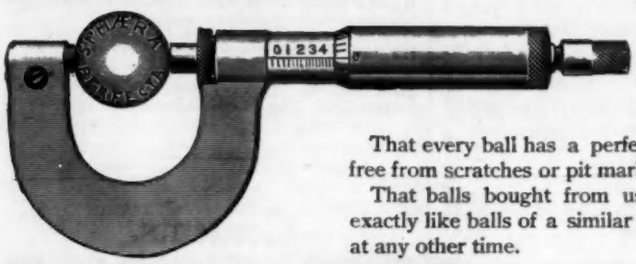

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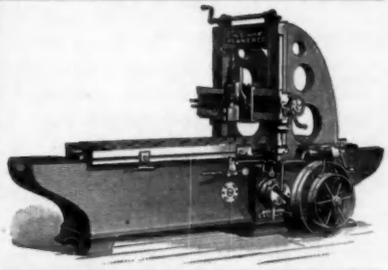

24 inches to 36 inches square.

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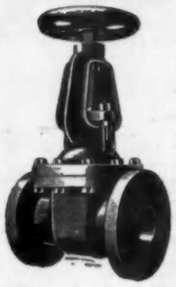

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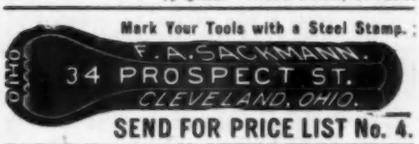

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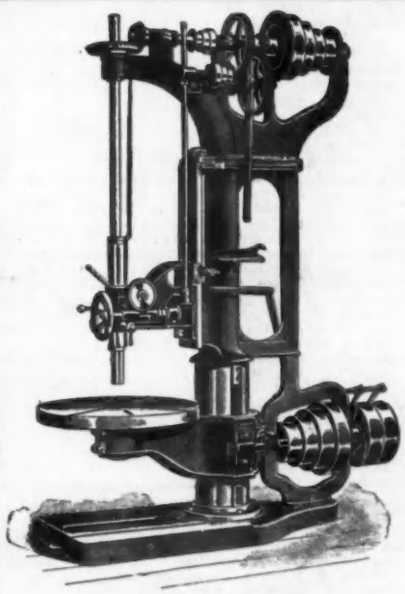

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AMERICAN MACHINIST

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"Machine Tools," by John Richards.

We think our readers generally will agree with us that the articles by Mr. John Richards on "Machine Tools," the third installment of which appears in this issue, are of exceptional interest and value. The very wide experience of their author and the thoroughness with which he has studied machine-tool construction, here and abroad, make what he has to say upon that subject especially valuable.

No one who builds or uses machine tools and who wishes to be intelligent regarding them can afford to miss these articles. We do not, of course, mean to assert that there is no room for difference of opinion in some of the points touched upon by Mr. Richards, and he himself would be the last to assume the position of a dictator, or to attempt to lay down the law to all machine-tool designers, but he is in the habit of having a reason behind his opinions, and does not blindly follow the ideas or practice of others without knowing their rationale. Machine tools designed by him many years ago were far in advance of the practice of the day, and are still excellent examples of tool designing.

In wood-working machinery Mr. Richards is especially a pre-eminent authority, and many of the best things to be found to-day in that class of machines were originated by him. He is also an authority on centrifugal pumping machinery, and all his work is marked by what may be called conservative originality, i. e., originality which does not consist in making things different simply for the sake of having them so, even if inferior to regular practice, but of new ideas based upon sound and well established principles. The articles will continue for several weeks yet to come, and although each one will be separately readable without reference to the others, no one interested in machine shops should miss a single one of them.

English and American Engineering Methods.

There is no more prolific source of profit to the engineer or the mechanic than the comparison of methods followed in different countries. In our issue of May 4 we made some comments on English and American methods of locomotive and bridge construction, but the comparison of the methods followed in the two countries may be profitably carried much further.

In the "Engineer," of London, for April 21 we find some comments on the Atbara bridge, the contract for which was recently placed with the Pencoyd Iron Works. The "Engineer" describes the plan of procedure in England in such cases in the following graphic language:

"Mr. Y. Level, M. Inst. C. E., has an order for a big bridge to be erected in Lost Atalanta. He gets out a general design, and the young men in his office then calculate stresses, and so on, and after a time the drawings are submitted for tender. Now, Mr. Y. Level never set foot inside a steel works. He only knows in a general way how steel is rolled. To him one section is as available as any other. When the bridge builder comes to tender for the work he finds that there are all manner of abnormal sections of angle and channel and H-irons; out-of-the-way thicknesses of plate, etc., specified. In short, there is not a portion of the bridge that has not to be specially made for that bridge, and it will be of no use for any other bridge. Not only have particular sizes and sections to be rolled, but the precise quantity to the ton must be rolled, for the surplus will assuredly be left on the maker's hands. We may cite two facts in illustration of what we advance. We have seen a specification for a large lattice bridge in which the thickness of the bars was specified to the one-hundredth of an inch. If the engineer who drew up the specification had been in touch with steel makers he would have known that it is impossible to roll bars or plates to 1-100 inch. The smallest available fraction is 1-64 inch. In the second case, a bridge-building firm called upon to use certain abnormal sections; knowing that an order for a second bridge would be given out, and that they would probably get it; feeling certain that the bridges would be practically identical, the spans being nearly the same; and finding that by increasing the quantity of the steel ordered they would get a reduction in price, bought about twice as much as they wanted for the first bridge. They secured the second bridge, and then found that not an ounce of steel of the special section was used in it. It was left on their hands.

. . . . . .

"The exasperating feature of various transactions is that while the British manufacturer is tied and bound hand and foot by rigid specifications, carried out under the eyes of exacting inspectors, American bridges, or locomotives, or engines, or tools, are accepted apparently on the reputation of the makers.

. . . . . .

"There is now no reason why large numbers of bridges should not be manufactured to a very few uniform patterns by the mile, and of sections which the designer knows to be readily available. The American steel maker takes care that the engineer shall know precisely what sections and sizes he can have ready to his hand, and the engineer works these into his design. On a new railway in a new country there are required, say, fifty bridges; they are all to carry the same loads. A large proportion of these bridges can be constructed as multiples of a given span. . . . This is done to a considerable extent in the United States. There every effort is made to secure uniformity of type throughout. The effort may not always succeed, but it is none the less praiseworthy. English civil engineers will put up a totally different bridge over every river. Not the least attempt is made to secure uniformity. The multiplication of types is supposed to redound to the honor and glory of the engineer. At this moment bowstring girders, plate girders, and lattice girders can be seen almost side by side in this country. Indeed, it is not necessary to go outside the metropolitan

boundaries to find examples. . . . If the civil engineer would rest content with stating that he wanted to buy bridges which would carry given loads with such and such spans, he would find himself supplied with just what he wanted with certainty and despatch. . . . We expect, of course, to be told that we suggest what cannot be done. The answer is simply that it is done every day, and has been done daily for years in the United States. . . . There is a time when it is good to be angry, and we are not surprised that manufacturing engineers in this country begin to lift up their voices and cry aloud."

American engineers may well be excused for viewing with a certain degree of complacency such a testimonial to their methods as this, especially when it comes from the not long ago consistent lip-turner at everything American in engineering. The "Engineer" has not yet, however, reached the root of the difference between English and American practice in engineering design and construction, although it is making good progress in that direction. In general, that difference may be said to be—and here we refer to engineering practice as a whole and not as confined to any particular field—that in England the plans for important engineering constructions originate with the consulting engineer, who acts as an intermediary in that respect between the buyer and the seller, while here the plans originate with the builder, the work of the consulting engineer, or more usually the purchaser's engineer, being merely to see that the proffered plans meet the requirements of the case. The consulting engineer, in the English sense of that term as designer, is almost unknown in this country, and while the employment of consulting engineers here is undoubtedly increasing, there is no tendency to adopt the English system in their work. Of course, for unusual cases outside the limits of ordinary work, the plans for a given piece of work are and always have been prepared by the engineer of the work, but for ordinary cases the procedure is for the consulting engineer, if one is employed at all, to issue specifications only, these specifications dealing with generalities only, that is covering the capacity of the structure, the strains which are not to be exceeded, the prescribed duty in the case of a steam engine, and such other limiting conditions and broad features as need to be prescribed. These specifications are, and are intended to be, nothing more than a general guide to the bidders, to enable them to figure on the same basis for a machine or structure intended for a given purpose. On these specifications the bidders make their tenders, said tenders including the builder's own plans and detailed specifications. These plans may, and usually do, differ videly among themselves, each bidder figuring to accomplish the required result in his own way, the result often being that very diverse designs are submitted for the same work. At this point it is the business of the consulting engineer to examine the bidders' plans and specifications, eliminate those, if any exist, which do not meet his own specifications, compare the remainder, and determine upon the one which he considers the most suitable. The bidders' specifications may not at all points agree with those submitted to him, or in some cases alternative bids may be offered—one on the engineer's specifications and one in accordance with the bidder's ideas—the latter being usually, of course, at a lower price, because drawn to conform with the regular practice of the bidder's works. The contract as finally placed may embody features drawn from both sets of specifications—the final specifications being of a composite nature, and usually better than either one from which they are taken, on the principle that two heads are better than one. In other words, the American consulting engineer really consults someone, and with advantage to all concerned.

It is this system of obtaining plans from bidders which leads to the greater uniformity of design which the "Engineer" notes as characteristic of American work, although this uniformity does not extend to the work of different constructors, as the "Engineeer" seems to imagine. It will be seen that the advantages of this system cannot be reached by the English method. Were an English consulting engineer to confine himself to one general design, it would benefit no one, except in a few cases, unless that design should be drawn to favor some particular constructor.

This system is as distinctly American as is our system of specialization in shop production, and may be looked upon either as the cause or the outgrowth of it, though more largely the outgrowth than the cause. It compels the builder to be an engineer as well as a constructor, and introduces an element of competition in the quality of the designs submitted, as well as in price, thus leading to rivalry in the direction of excellence of design, which is absent from the English system. Moreover, the plans submitted by each bidder are in acordance with the practice of his works. Each new piece of work is not a thing apart from all that has gone before or that will come after it, but is a consistent outgrowth of previous work, and in most cases is, at least in part, a repetition of previous work.

To American engineers the English system seems cumbersome to the last degree, and with no compensating advantage whatever. It puts a premium on diversity of design for no other purpose than to gratify vanity or caprice, while it is hardship at every point and cannot lead to as good results, technically speaking. Our system of specialization cannot but lead to greater skill in design, as well as greater economy in construction, than the opposite system.

It is just as true in engineering as in medicine that if one wants the best service he must go to a specialist. The American system is also a time saver at every point. In every drawing office devoted to a specialty, time-saving methods and short cuts are developed, by the aid of which calculations and plans can be made in a fraction of the time required where everything must be worked up from first principles. Mere comparison and analogy with previous work will often enable a general plan, which, with specifications as to leading dimensions, is sufficient for the purpose of the tender, to be gotten out before any detailed designing has been done, and before the general practitioner could get his plans fairly under way. When the order is finally placed everything favors dispatch. The preliminary working general design becomes a mere skeleton, scarcely intelligible to anyone but the man who made it, and shows little more than leading points and distances between centers. The details being in line with regular work, are much more quickly drawn than complete original designs could be prepared. The drawings for the most complicated pattern work are gotten out first and rushed into the shop, without waiting for the others, while for forgings and other simple pieces, quickly-made sketches answer every purpose, and when done the machine is the work of a specialist with expert knowledge and experience embodied in every feature.

The advantage to the builder of working from his own plans, made in full view of the facilities at hand, and of the methods of construction to be followed, are too obvious to need rehearsal, but they are not greater than the pecuniary advantage to the purchaser. The consulting engineer on the English system has no pecuniary or competitive interest in saving his client's money. All of the bids being on the same plans, the element of cost, as affected by the design, is eliminated from the competition. With no counter-acting influence the tendency of the engineer is to resolve every doubt by making everything excessively safe. He calls for forgings where castings would answer every purpose; he provides excessive weight of section, and, having no experience as a constructor and being without the constructor's knowledge of the cost of alternative constructions, he calls for expensive details where cheaper ones would do as well.

The English system is also bad because it divides responsibility. In case of failure the builder can usually attribute it to claimed defects in the plans. The American system fixes responsibility, and on a party who is financially responsible. The American system then offers the advan-

tages of competition in designs, cheapness of construction, economy of time, and greater protection to the purchaser.

The "Engineer's" recommendation that consulting engineers work more in harmony with constructors will not cure the evils complained of. The proper thing to do with the consulting engineer as a designer is to abolish him altogether. Plans should originate with builders, who alone can have the expert knowledge which allows proper discrimination in design, and combination of cheapness with excellence.

Commercial Review.

NEW YORK, SATURDAY EVENING, May 6, 1899.

MACHINE TOOL MARKET.

Demand for machinery could not under any reasonable conditions grow more active than it had become a month ago. Orders are still coming in almost as plentifully as they were then, but the maximum of activity in trade has been reached, and apparently it has been passed. Prices are now practically stationary. Some few advances, however, are being made by manufacturers who have lagged behind others in this particular. For instance, an Indiana company has added 7½ per cent., which will bring its rates up more nearly in line with others, and a Cincinnati company has given notice of an increase in certain large tools, to take effect June 1. Deliveries rule about the same as hitherto, three months being a fair average for large tools, although in some cases from six months to a year is required.

It does not appear that the advances in export prices have yet greatly affected the placing of foreign orders. A representative of a concern handling the products of two heavy tool factories, which about six weeks ago made an advance of 10 per cent. in export prices, states that he sees no falling off in sales. A man in close touch with the German market, who prophesied that the advances would have such an effect, does not see much of it as yet, although he notices that orders for heavy tools are relatively a little slow, which may be due to prices or deliveries. He is of opinion that the foreign tool trade of this year will equal that of last year, to say the least, though it is not universally conceded that present indications point that way.

It is contended in justification of raising export prices, that when American tool builders first entered the foreign field they were over-cautious and offered greater inducements in the way of prices than were really necessary. To this the retort is made that our prices were higher than those for foreign-built tools, and that the special inducements we made for export sales were chiefly free boxing and free delivery on steamship piers.

We do not know that there is ground for asserting that our tool builders have become culpably indifferent to the export market, but it is well to emphasize the need of nipping in the bud any tendencies in that direction. There is food for grave reflection in the jocose remark of the representative of a celebrated Eastern manufactory that his firm were naming long deliveries to the foreigners so that they might not have to be bothered with the orders. "We take what comes to us willingly enough," he added, however, in a qualifying way, "though we don't put ourselves out to get it." There is said to be some dissatisfaction in Europe over the American way of doing business. Awhile ago when we had nothing to do at home we were greedily solicitous for their custom, and now that matters have brightened up on this side they think that we are turning to them a cold shoulder.

That our exports of raw materials have fallen off greatly is an admitted fact, and there is more justification for it than there would be for a similar condition in finished products. The following figures from the British Board of Trade returns show the imports of pig iron and unwrought steel into the United Kingdom from the United States for the last two years and the first three months of this one to be as follows:

1899.	Pig Iron. Tons.	Unwr't Steel. Tons.
January	14,621	12,034
February	13,528	5,206
March	9,401	5,992
Twelve m'ths, Dec. 31, 1898.	76,356	29,374
Twelve m'ths, Dec. 31, 1897.	91,196	25,927

The Carnegie Steel Company, which is to erect a new car axle mill, has placed with Bement, Miles & Co. orders for a large value of steam hammers and axle-turning lathes.

Industrial combinations have had an injurious effect upon the machine-tool trade, according to a dealer. In certain cases would-be buyers have withheld their purchases because they did not know what the trust they were entering would want to do about the order.

The labor question is one of the factors now affecting financial and economic conditions in the tool market. Wage advances, say, from $2.75 to $3.25 per day, have been one of the causes of higher prices of machinery. Now the foundry strikes in New England threaten to embarrass trade. The Providence situation has already been mentioned in this journal. Advices from Worcester also are to the effect that about half the foundries there are shut down. A tool company of that town claims that if the unions acquire control of the foundries and molders' demands are acquiesced in damage to business will result. One of the foundrymen states that it would reduce his output 40 per cent.

A buyer for a German machinery house recently purchased for shipment to Hamburg, eighteen machine tools of different sizes, notwithstanding advances of 10 per cent.

An export firm of this city has lately placed with manufacturers in Cincinnati and Hamilton, Ohio, orders for $16,000 worth of machine tools, including lathes, drills, planers, etc., for shipment with as much haste as possible to Genoa, Italy.

CHICAGO MACHINERY MARKET.

Buyers find extreme difficulty in securing deliveries on Corliss engines before next December. The filling up of some makers to that period, or beyond, turned the tide of buying to other makers, not quite so well sold up, and the latter are now equally favored with business. The feeling of the trade, as expressed here, is that demand for engines will not decrease in the near future and that a further increase in values under the circumstances is not unlikely. Taking this view, makers and their selling departments are not courting new trade. What comes to them unsolicited is welcome, if deliveries can be arranged, but a large percentage of the possible business is sent adrift because the makers cannot meet the wishes of the needy purchasers. The latter in many instances are shopping about, picking up anything that will temporarily answer their purposes. The buyers are themselves turning away trade, simply because they cannot take care of it. The profits thus lost, under the booming conditions of iron and steel manufacture, are so large that the buyers no longer quibble about prices. Their losses because of inadequate capacity loom up in proportions too large to permit of delays or matters of a few hundred or thousand dollars.

Perhaps the bulk of this large demand for engines and boilers is coming from the iron and steel industries. One large Western maker of Corliss engines has inquiries enough for blowing engines alone to enable him, if so disposed, to neglect all other varieties of engine manufacture. There is among the large combinations of iron and steel producers an earnest endeavor to add to their present producing capacity by better machinery and power equipment. For the moment the demand is of a volume far beyond the capacity of the machine builders to produce. Some recent sales have been made for deliveries extending from twelve to eighteen months. They include some orders from England for shipment fifteen months hence. The buyers could not obtain better deliveries from their home makers. Canada is also a fresh seeker for blowing engines.

The small trade in engines and boilers is not so universally good. Some makers of small power, say, up to 75 horse-power, say trade has fallen off with them very noticeably during the past month. One builder has advanced prices five times since February, and thinks the continued rise in the cost of material will still further drive prices upward. The first effect of these steady advances has been to discon-

cert the buyer, who often did not fully appreciate the admonition that quotation was subject only to immediate acceptance, but when the drift of things is thoroughly understood it is believed the effect will be to hasten orders. But even inquiries from small country buyers are now fewer than a month or two ago.

The E. P. Allis Company has sold six large blowing engines to the National Steel Company, and its total sales during the past several weeks exceed in value $1,000,000.

PITTSBURGH REPORT.

The iron and steel market, speaking generally, is very strong, and will probably continue firm for some time. There is not that tendency to "boom" the market that was the case a month or so ago. Prices have steadied down and quotations made are strictly adhered to, because the shops are so full of work that manufacturers care little for new orders at the present time. The only bad feature of the trade, as viewed from the manufacturer's side, is that a great amount of work now under way was contracted for some time before the last rise in rates, thus filling up the many plants with work which does not bring them much gain. It will not be long, however, before the work is "run off," and then they will operate under satisfactory conditions.

The numerous furnaces throughout the Allegheny County district are running to their fullest capacity. The product is enormous, but insufficient to meet the demands of the Pittsburgh manufacturers. Many heavy purchases of valley iron have been made lately.

The steel casting business has taken on quite a spurt during the last month or so. Two new concerns have been organized, one headed by Stewart Johnston, formerly connected with the Pittsburgh plant of the American Steel Casting Company, and the other by Messrs. Tinker, Marshall, Smith and others, the former being connected with the firm of Samuel Trethewey & Co. This will be known as the Union Steel Casting Company, and will have its plant located near the outskirts of the city, on the Allegheny Valley Railroad. The machinery for operating the plant will principally be furnished by the Westinghouse interests.

The Mesta Machine Company, lately organized by consolidating the interests of the Robinson-Rea Manufacturing Company and the Leechburg Foundry & Machine Company, will also make steel castings of all descriptions. The new plant at Homestead is now under way and will probably be ready for operation by June 1. The plant which Stewart Johnston and associates will erect will be located at Glassport, near McKeesport. Another plant to locate at Glassport is that of the Pittsburgh Horse Shoe Company, which has contracted for Tod engines and Bass boilers, Pittsburgh feed-water heaters, Lewis rolling mills, etc.

The Chester Rolling Mill Company, which will build its works opposite East Liverpool, Ohio, has purchased Cooper Corliss engines of 600 horse-power, and Babcock & Wilcox boilers, while the Lloyd Booth Company will furnish the mills.

Since the formation of the American Tin Plate Company and the purchase of the different plants in this neighborhood by the "trust" there have been several new companies organized for the manufacture of tin and terne plate. The two principal "non-trust" mills, so far, are the Alcania Tin & Terne Plate Company, now erecting its plant at Avonmore, Pa., and the Washington Charcoal Tin Mills Company, at Washington, Pa. It is understoond that Colonel Tyler, of the Tyler Tube & Pipe Company, of Wilmington, is at the head of the latter company.

Trusts in this locality are as thick as "flies 'round a molasses barrel." These include the manufacturers of fire brick, sewer pipe, pipes and tubes, engines, etc., and last, but not least, the trade papers. Where it is going to end, no one can tell, but many clerks are "trusting" that the efforts to combine interests will fail, and thus save them their positions.

MISCELLANEOUS.

The Watson-Stillman Company has more orders now on its books than ever before, the great difficulty being to keep everyone amiable in the matter of deliveries. The company is now building for the Ingersoll-Sergeant Drill Company a large vertical hydraulic forcing press of special construction. It is about 16 feet long, 100 inches between the rods, 150 tons in power at ends of beam and 300 tons on intermediate beams. The whole machine is mounted to raise the ram center about 38 inches. An order is also on hand to build several big hydraulic presses for Fayerweather & Ladew, belting manufacturers. The largest of these will take in a 100-inch belt.

Reference was made in these columns, March 9, to two 14-foot by 7-foot fans, direct connected to engines, which had been ordered of the Buffalo Forge Company for the Compania Metalurgica Mexicana, San Luis Potosi, Mexico. We are advised by the builders that this is the maximum size hitherto made for such work. They believe these to be the largest, if not the first, mechanical induced-draught fans ever used in Mexico. They have installed some of the same size in the enamelled paper mills of S. D. Warren & Co., Cumberland Mills, Maine. The last important order of this nature has been received from Johannesburg, South Africa, and calls for two fans of very nearly the same proportions, but having direct attached, double upright, double acting, enclosed engines of the United States Navy type.

Quotations.

NEW YORK, Monday, May 8.

Iron—American pig, tidewater delivery:—

Pennsylvania irons:

No. 1 X foundry	$16 75 @ 17 00
No. 2 X foundry	15 75 @ 16 00
No. 2 plain	15 25 @ 15 50
Gray forge	14 75 @ 15 00

Alabama irons:

No. 1 foundry	16 00 @ 16 50
No. 2 foundry	15 25 @ 15 75
No. 3 foundry	14 75 @ 15 25
No. 1 soft	16 00 @ 16 50
No. 2 soft	15 25 @ 15 75
Foundry forge	14 25 @ 14 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.50 @ 1.55c., nominally; refined, 1.58c., upward. Store prices: Common, 1.70 @ 1.75c.; refined, 1.75c. upward.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 2.00 @ 2.05c.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 3.00c.

Copper—Carload lots, Lake Superior ingot, 19c. on spot, 18½c. on near future deliveries; electrolytic, 17½ @ 18c.; casting copper, 17 @ 17½c.

Pig Lead—Carload lots, 4.45 @ 4.47½c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 25.75 @ 25.85c., f. o. b. New York.

Spelter—Prime Western, in carload lots, 6⅞ @ 7c., New York delivery.

Antimony—In cask lots and over, 10 @ 11c., according to brand and quality.

Lard Oil—Prime City, present make, 43 @ 46c., in wholesale lots.

Back-Geared Shaper.

We give engravings of an improved shaper which, although it conforms in general to the standard designs, possesses some new features of interest. So far as the photograph indicates, it is a shaper of the usual pillar and slotted lever type, but of somewhat unusually heavy proportions designed to give it rigidity and strength, and it will be noticed that the slide in which the ram works is extended both front and back to give great length of bearing. An opening is provided through the column below the ram, which permits long work up to 3 inches diameter being passed through the machine.

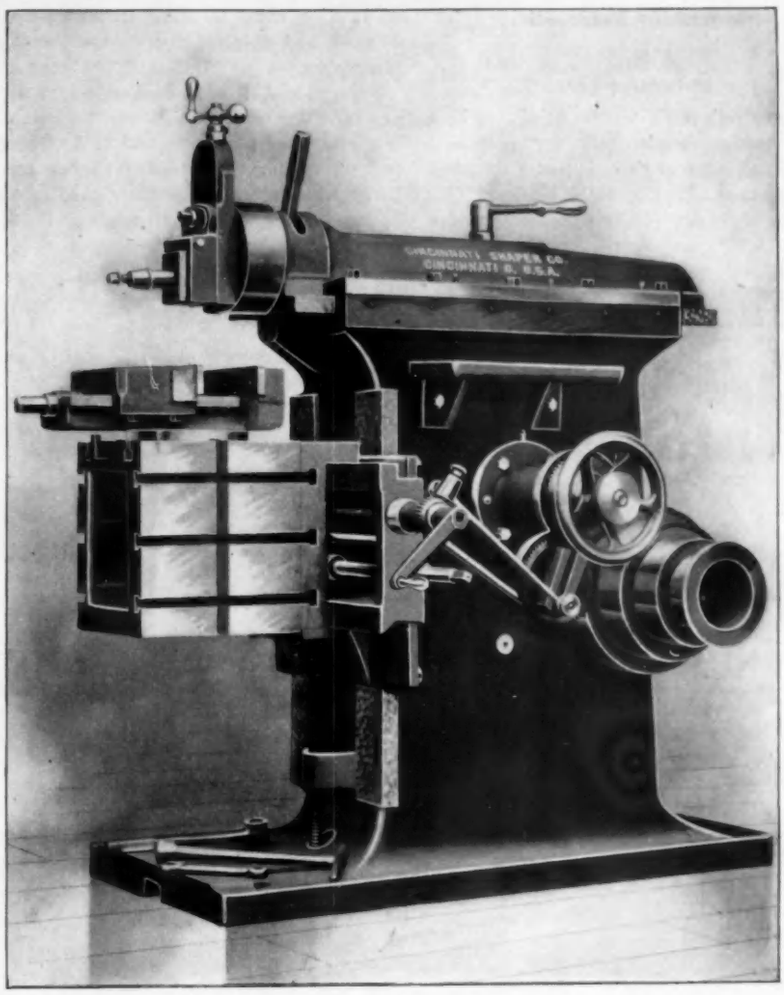
The gearing of this shaper is its chief novelty, and the arrangement of this is shown in Figs. 2 and 3, where *a* is the main gear, which carries on its face the movable crank-pin and block. This is driven by engagement with pinion *b*, which pinion, for light work and short strokes, is driven directly by the loose spur gear *c*, which in turn is driven by

clutch teeth formed on its side and which engage with similar teeth formed on the side of the sliding splined pinion *d*. When, however, heavier cutting or long strokes are to be taken, pinion *d* is moved to the right, disengaging the clutch teeth and sliding the pinion itself into engagement with spur wheel *g*, thus increasing the ratio of the gearing and giving four additional speeds.

This movement of the pinion clutch *d* is effected from the rear of the machine by the lever *f*, which, however, does not show in the photograph, and above it is a removable cover which permits access to the gearing for inspection and oiling.

The position of the ram is changed by the rotation of a screw, the squared end of which projects from the rear end of the ram, and the stroke is changed by turning the hand wheel seen on the working side of the machine, this having clutch teeth which are released by the action of the spring when the knurled disk is loosened, and the wheel is then free to be turned to any desired position; graduations on the hub of the wheel and the upper feed gear indicating the length of stroke to which the machine is set.

There is a ball thrust bearing on the screw for lifting the cross-slide and knee, and all traversing screws are graduated. The machine shown is called the 16-inch shaper and has an extreme stroke of 16½ inches; vertical travel of table of 16 inches; horizontal movement of table, 21½ inches; feed of head at any angle, 6¼ inches; bearing of the ram in column, 29 inches long by 10½ inches wide, and complete weight 2,200 pounds. It is made by the Cincinnati Shaper Company, Cincinnati, Ohio.



BACK-GEARED SHAPER.

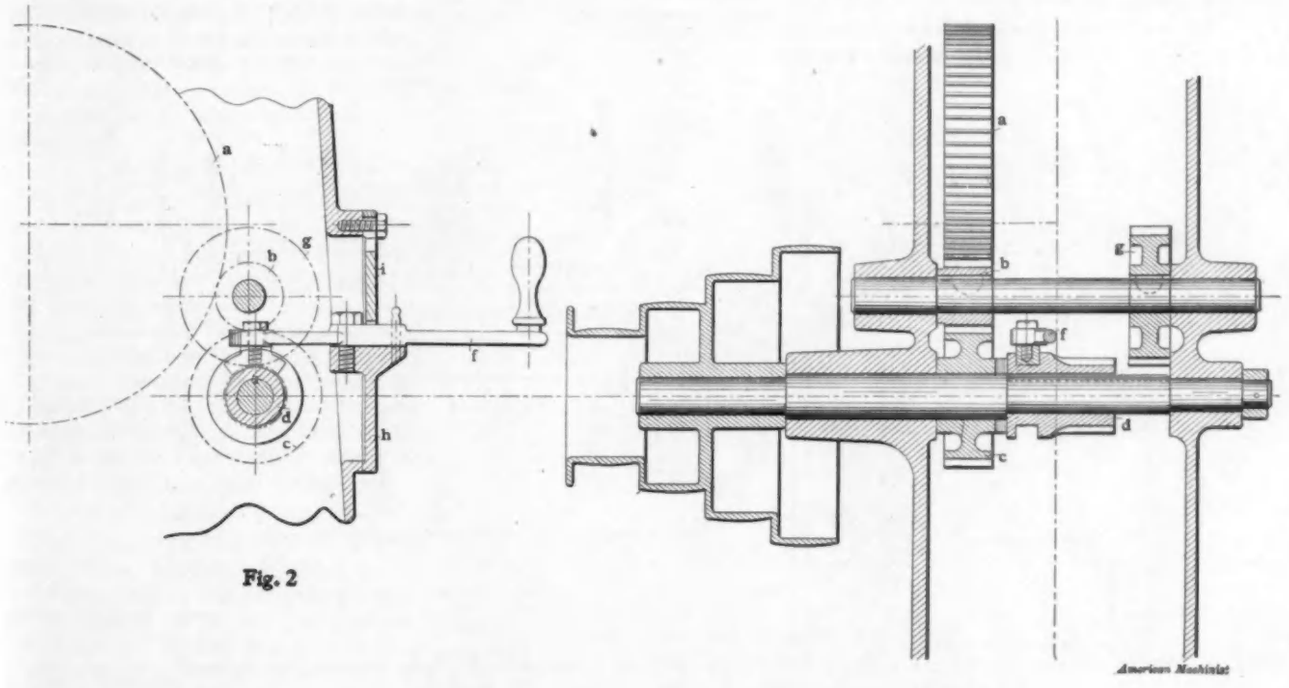


Fig. 2

Fig. 3

ARRANGEMENT OF SHAPER BACK-GEARS.

Machine Tools—III.

BY J. RICHARDS.

CONVOLUTE TAPS.

The "relieved" method of making screw-cutting implements for both external and internal threads had a complete development in Bodmer's works. The dies in his screw plates were so arranged by causing them to stand in an involute position and give clearance from the cutting edges.

Figs. 11 and 12 from Bodmer's drawings of 1841 show what he calls his "convolute" screw taps, and Figs. 13 and 14 a chasing tool for cutting the threads on screw taps, corresponding to similar tools used in the Industrial Works at Philadelphia in 1867, but Bodmer's are better contrived in respect to holding the cutters.

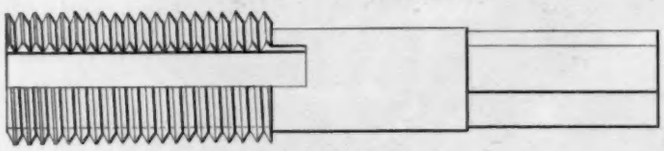


Fig. 11

Fig. 12

BODMER'S RELIEVED TAP.

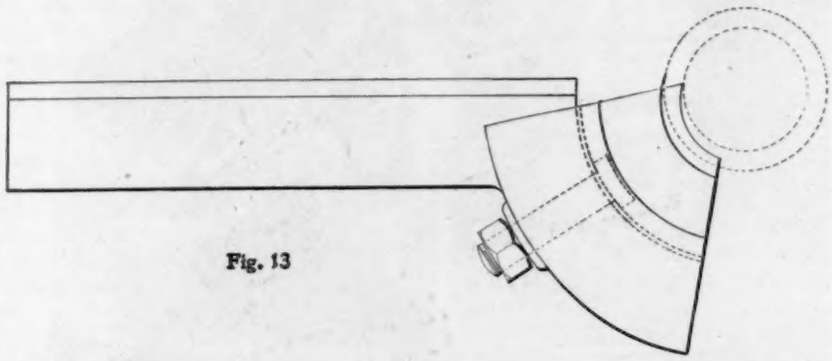


Fig. 13

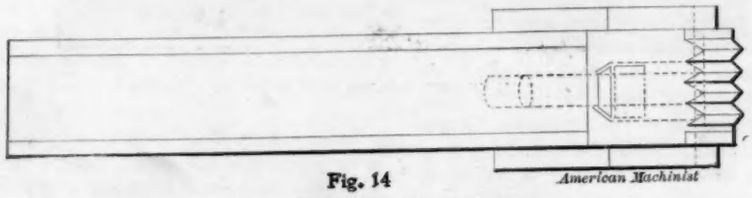


Fig. 14

BODMER'S CHASING TOOL.

Figs. 15 and 16 are side and end views of a small lathe designed by Bodmer for cutting convolute taps. This lathe, which can be made out in all of its essential features from the drawings, was self-acting in so far that one motion of a lever reversed the motion and set the tool forward at each cut. The various details are all illustrated in the original drawings, but would consume too much space to reproduce here. All points of interest can be traced out in these views by skilled readers, except, perhaps, the tool-setting mechanism, which is shown in the detail drawing, Fig. 17. These drawings, it will be understood, are from Bodmer's patents, 1839 to 1841.

CORRECTING THE PITCH OF SCREWS.

Besides exercising a high degree of constructive skill Bodmer's attention was directed to a great many things that Professor Sweet would call "refinements," some of which will be noticed further on. In his patent of 1841, the one being quoted from at present, he illustrates and describes a machine for correcting the pitch of screws, a problem by no means finished at this day. It is to be regretted that space will not permit reproduction of the drawings of this machine, which requires five figures to illustrate it.

The scheme is, however, the same in principle as that proposed many years ago by Professor Sweet—the use of a master screw in a nut that exceeds the screw in length.* Bodmer placed his master screw in a long nut composed of two pieces of wood that could be clamped together so the thread, which was of angular form, would "bite into the wood," and thus form a matrix and the resulting movement com-

*Our understanding of Prof. Sweet's plan is that the screw and nut were of the same length.—Ed.

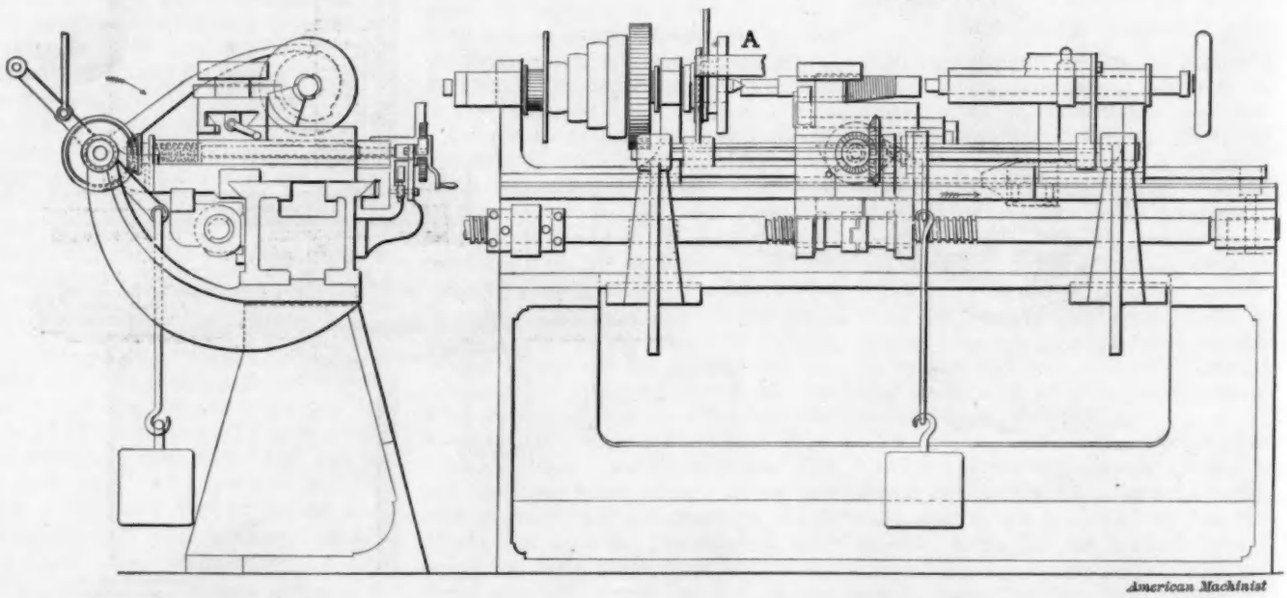


Fig. 16 Fig. 15

BODMER'S RELIEVING LATHE.

municated to the blank to be cut, nearly, if not wholly, eliminating any error of pitch, on the principle of "general average." The search for such accuracy at that time, we may safely conclude, was not common with machine tool makers, although there had been earlier attempts in the same direction, notably that of Clement, about the beginning of the century, who made efficient machines to correct screws, but of these no available drawings are known to exist.

DRILLING MACHINES.

The drilling machine shown in Figs. 18 and 19 formed a portion of Bodmer's outfit at Manchester. It has a number of interesting features, but aside from ingenuity, which usually spoils a drilling machine, was an advance on other practice of the time. The cone, or step pulleys,

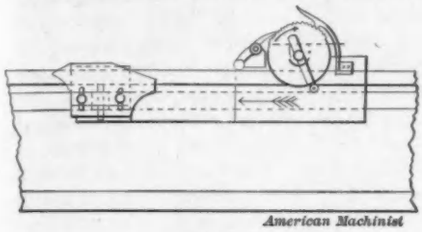


Fig. 17

TOOL ADJUSTMENT OF RELIEVING LATHE.

of which there are two sets, are so arranged that either of these pulleys will drive either of the two spindles. The feed is positive by means of a differential movement between the spindles and the screw shells, in which the spindles slide, produced by the spur-wheels *A* and pinions *B*, seen in Fig. 18. There was also a quick return motion of the spindles, accomplished by shifting the band to the lower pulley C, so the upper pair of wheels and the screw shells D would revolve, while the drill spindle would stand still. Whitworth afterwards greatly simplified these motions, as will be explained in a future place.

UNIVERSAL CHUCKS.

Figs. 20 and 21 represent a universal chuck by Bodmer, which for proportions will compare favorably with modern practice. The jaws are held in by means of the nuts *A*, which were circular shells that fit into bored seats or guide-ways. Chucks in their multifarious forms are an American invention, and are especially elaborate, but fifty years ago this one was certainly good practice. The bevel wheels in the center were covered by a plate with a hole through it for drills or reamers.

CRANK PLANING MACHINE.

Figs. 22 and 23 show two views of a crank planing machine that except for its architectural frame was not a bad example of tool design. This was no doubt the progenitor of Whitworth's shaping machine, adapted to planing special work, as indicated by the piece *A* in the machine, but was wanting in many features of con-

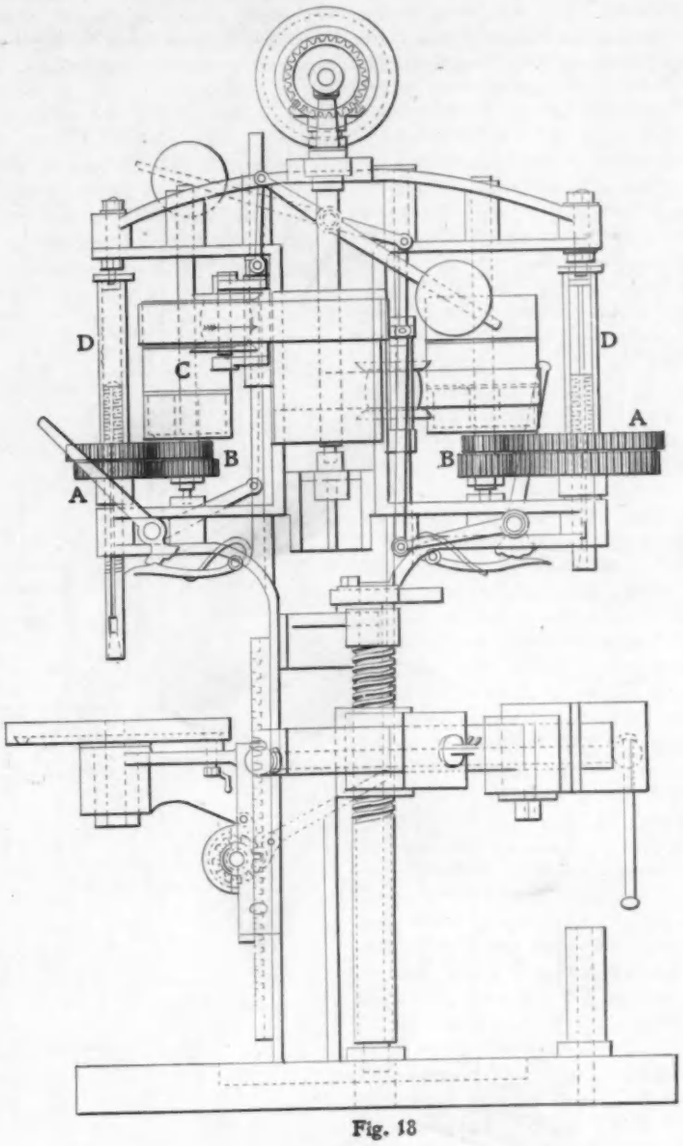


Fig. 18

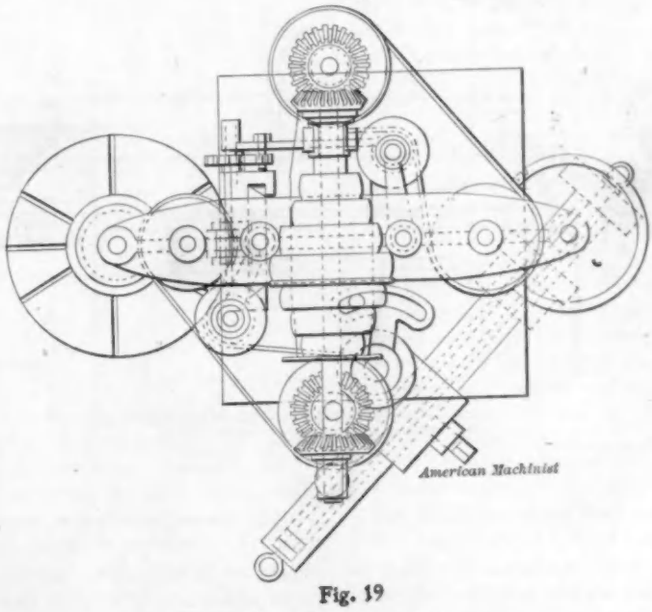


Fig. 19

BODMER'S DRILLING MACHINE.

venience attained by moving the tools instead of the work. The tool-lifting devices and other things are shown in detail, the drawings of these not requiring reproduction here. The machine, as a whole, occupies too much room in proportion to its working range, and has a "wooden frame" appearance, but for fifty years ago, when planing machines were a new invention, is a good example of design. One feature worthy of consideration is that the bracket supporting the driving pulleys was arranged to swivel about the axis of the crank wheel, so that the machine could be set in any desired position in respect to the line-shaft from which it was driven.

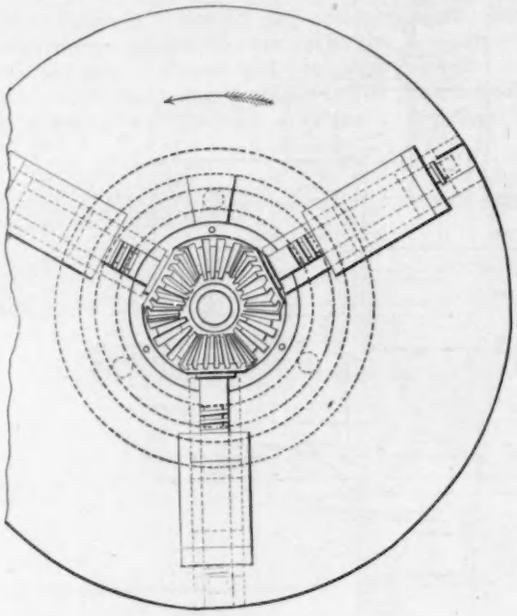


Fig. 20

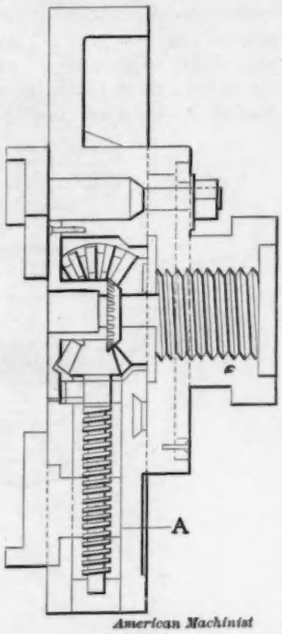


Fig. 21

BODMER'S UNIVERSAL CHUCK.

The tool-lifting devices on this machine are less complete than were employed by Bodmer on his large planing machines. In respect to these latter, they were very ingenious, considering that planing machines were at that time very crude implements, mostly driven by winding chains.

PLANING MACHINE GEARING.

Figs. 24 and 25 are selected to show a very interesting feature of Bodmer's practice—the method of moving the tables of planing machines. This gearing consisted of a section of a large screw placed beneath the tables, meshing into a rack or segmental nut *A* that extended along the bottom of the table *B*. The axis of the screw was parallel to the line of the table's movement, and it was driven by gearing that will be plain from the drawing. The action from this gearing was analogous in some respects to the Sellers method, so successfully introduced in this country at a later period. Some readers may conclude that it is quite the same thing, but it is not, as will be more fully explained when the Sellers gearing is discussed in a future place. The screw rack of Bodmer will at first seem a difficult thing to make, but this was not the case. The rack was composed of segments of a nut set longitudinally and were cut in a simple manner by combining six or more of these segments in the form of a cylinder and cutting a thread through all of them at once by means of a stiff boring bar placed

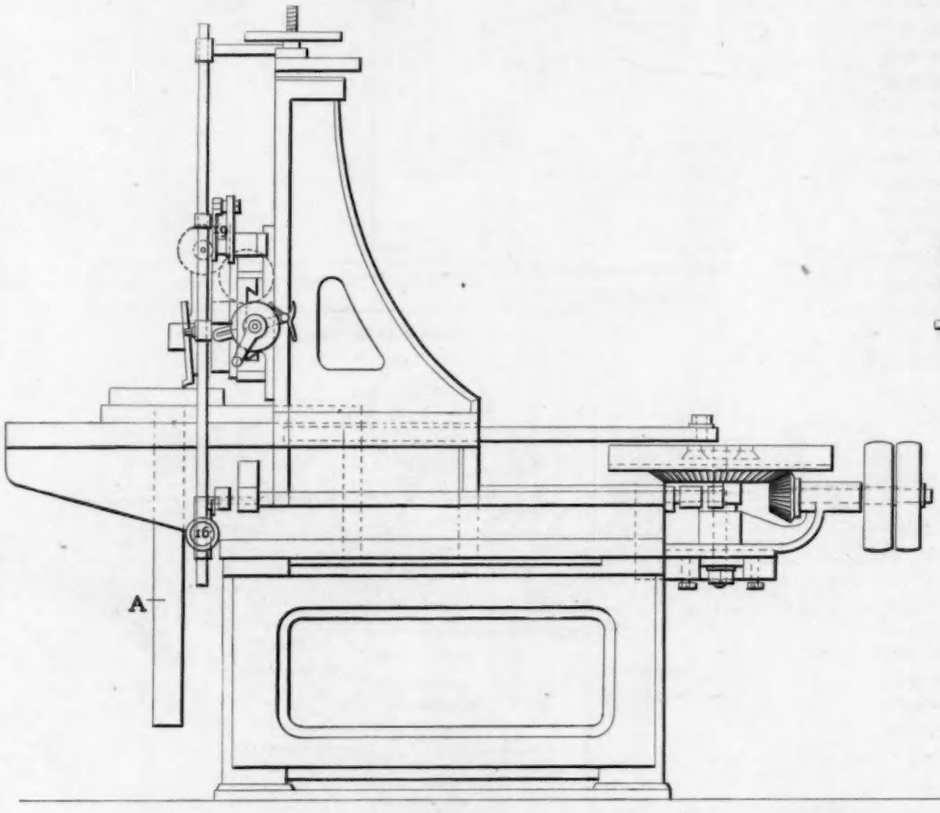


Fig. 22

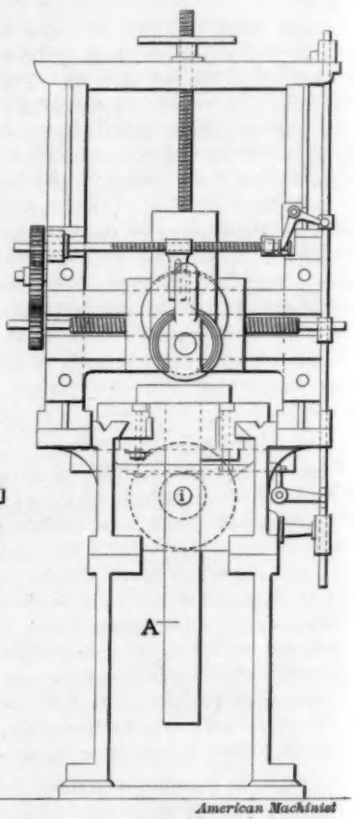


Fig. 23

BODMER'S CRANK PLANER.

in a lathe. If the cylinder was 3 feet long the six pieces when abutted together would make a rack 18 feet long, or if the cylinder was composed of eight staves or segments these would make a rack 24 feet long.

The difficulty of maintaining a thrust bearing for the screw shaft, the high speed and consequent wear of the screw threads and the difficulty of providing lubrication lead to a suspicion that the scheme was one of contriving rather than successful performance, but it shows fertility of resource creditable for the time.

The belt shifting mechanism, which is hard to follow out from the murky descriptions given, seems to be devised with the object of moving the belt guide *A* parallel across the faces of the pulleys *B*, a necessity arising out of the circular form of the eye which is the best if a parallel movement can be attained. It is left as a puzzle for ingenious readers.

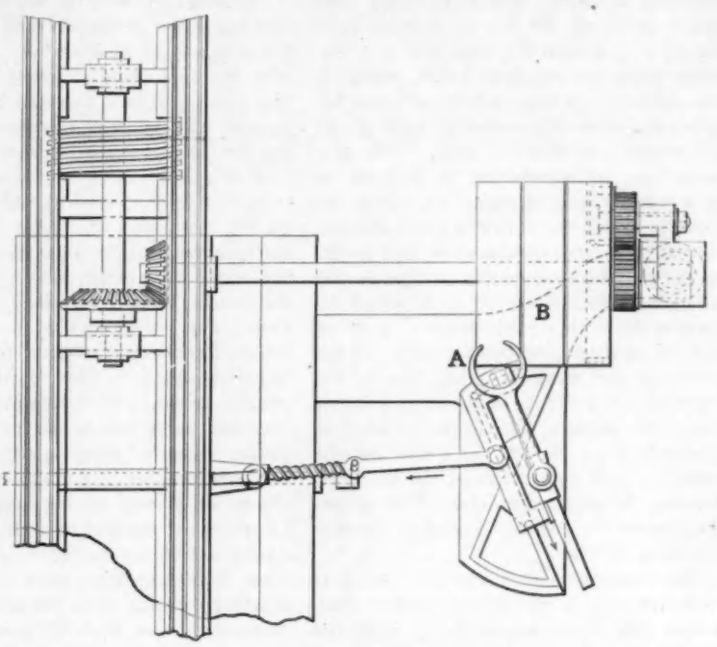


Fig. 25

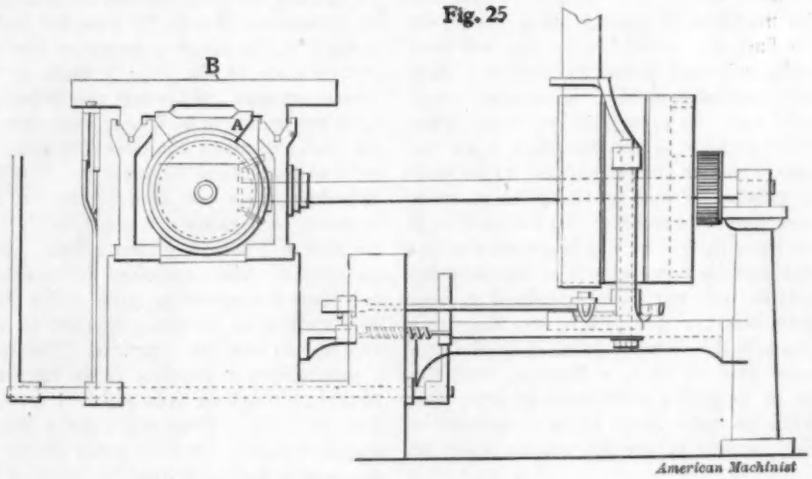


Fig. 24

DRIVING GEAR OF BODMER'S PLANER.

Track Scales for Testing Materials.

BY PETER H. BULLOCK.

Of course no one would expect to use common scales for testing where great accuracy was necessary, such, for instance, as measuring the elongation of metals under strain; but there are very many tests that may be made where it is desired to find the deflection of materials under certain loads, or to find the ultimate strength of some part or fixture.

I had a heavy spiral spring that was to support about five tons, and it was desirable to know just where it would stand in its housings when the load was applied. A freight car was placed on the railroad scales and carefully weighed. A timber was put through under the car, one end on blocks and the other on a jack screw, and both outside of the platform. The spring was then put between the bottom of the car and the top of the beam and the jack screw worked until the scales were relieved of the five tons. Just this weight was carried by the spring, and by noting its length we knew where it would stand when in its final position.

In another case two 10-inch steel beams, 20 feet long, were to support a certain weight all of the time, and a known amount more at certain other times, and it was desirable to know what the deflection would be under each separate load. There may be rules and formulas that give this information, but it is sort of satisfying to know just what your particular beam will do. With a loaded car on the track at each end of the scales and the beams lengthwise the platform, with their ends under the ends of the cars, and the jack screw under blocking at the middle, it was possible to accurately weigh off the loads and note the deflection.

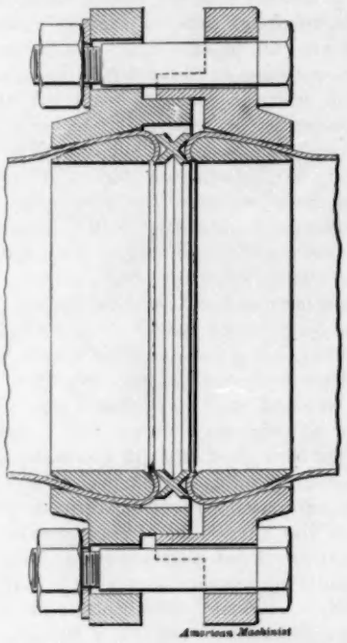
Not long since some shaft hangers were put up under my direction, and a question arose as to their strength and safety under regular working conditions. There was no particular evidence against them, except that they looked light generally, and especially so at a certain point. The two hangers in question supported a shaft and pulley weighing about 800 pounds and a directly vertical pull of a 20-inch belt, transmitting 50 horse-power through the 28-inch diameter pulley, at 350 revolutions per minute. It will be seen that this is not an excessive strain under these conditions, yet as the strength of the hangers was under suspicion, I decided to break one of them and see how weak or strong it was. In this case a car was put on the scales, weighed, and the hanger bolted to the floor of the car, looking up. A beam was put through the car doors, over the hanger, one end on an upright and the other on a jack as before. A short piece of shaft was put in the hanger box and chained to the beam above it. I then moved the pene back 5,000 pounds and jacked till it balanced, then moved 500 pounds at a time till there was a strain of 16,000 pounds. At that time it began to look as if it were about to break, and 50 pounds were added at a time. When the load reached 16,600 the hanger broke where it was bolted to the car floor, and not in the part where it had been suspected of weakness.

As was stated in the beginning, scales are not testing machines, but very much valuable and accurate information can be got with little or no expense that might never be had if one should wait for time and opportunity to send to some regular testing laboratory.

A local bicycle dealer tells of a boy's wheel which came in for repairs and it was found that one tooth was missing from the rear sprocket wheel. On being questioned, the boy said he had cut it out with a cold chisel, but he couldn't "see that he went any faster." He had been told that decreasing the number of teeth in the rear sprocket raised the gear.

For Coupling Thin Metal Pipes.

The cut, which explains itself completely, shows a method of coupling thin metal pipes which seems to be quite neat



COUPLING FOR THIN METAL PIPES.

and effective. It is a German invention and also recently patented in the United States.

Deflection of Cylindrical Helical Springs—II.

BY ROBERT A. BRUCE.

For the purpose of quick tentative calculations on the deflection of springs, the diagram is to be preferred. It has been constructed on the same lines as the diagram of the preceding article, and the general method of using it is the same.

As the diagram stands (without the subsidiary use of reduction scale and using direct readings only) it will answer any question of the following nature: For a steel spring composed of nineteen effective coils of square section, (1) given d the side and D the helical diameter, find W_1, the axial load to deflect the spring by one inch; (2) similarly given d and W_1, D can be found; or (3) given W_1, and D, d can be discovered.

The method of procedure for the first process of finding the load to deflect the spring one inch is as follows: Find the side of section on the right or left-hand scales, follow the horizontal line passing through this point till a diagonal line is reached marked with the required value of D, the helical diameter; then follow vertically till the scale of "*Force* to deflect spring by one inch" is found, and the required axial load can be read directly. The upper scale is used for the upper cluster of diagonals. The inverse operations need not be described in detail.

In any of the processes named, all confusion as to which scale is to be used for W_1 may be avoided if it is remembered that in tracing vertically, the space between the sets of diagonal lines must never be crossed.

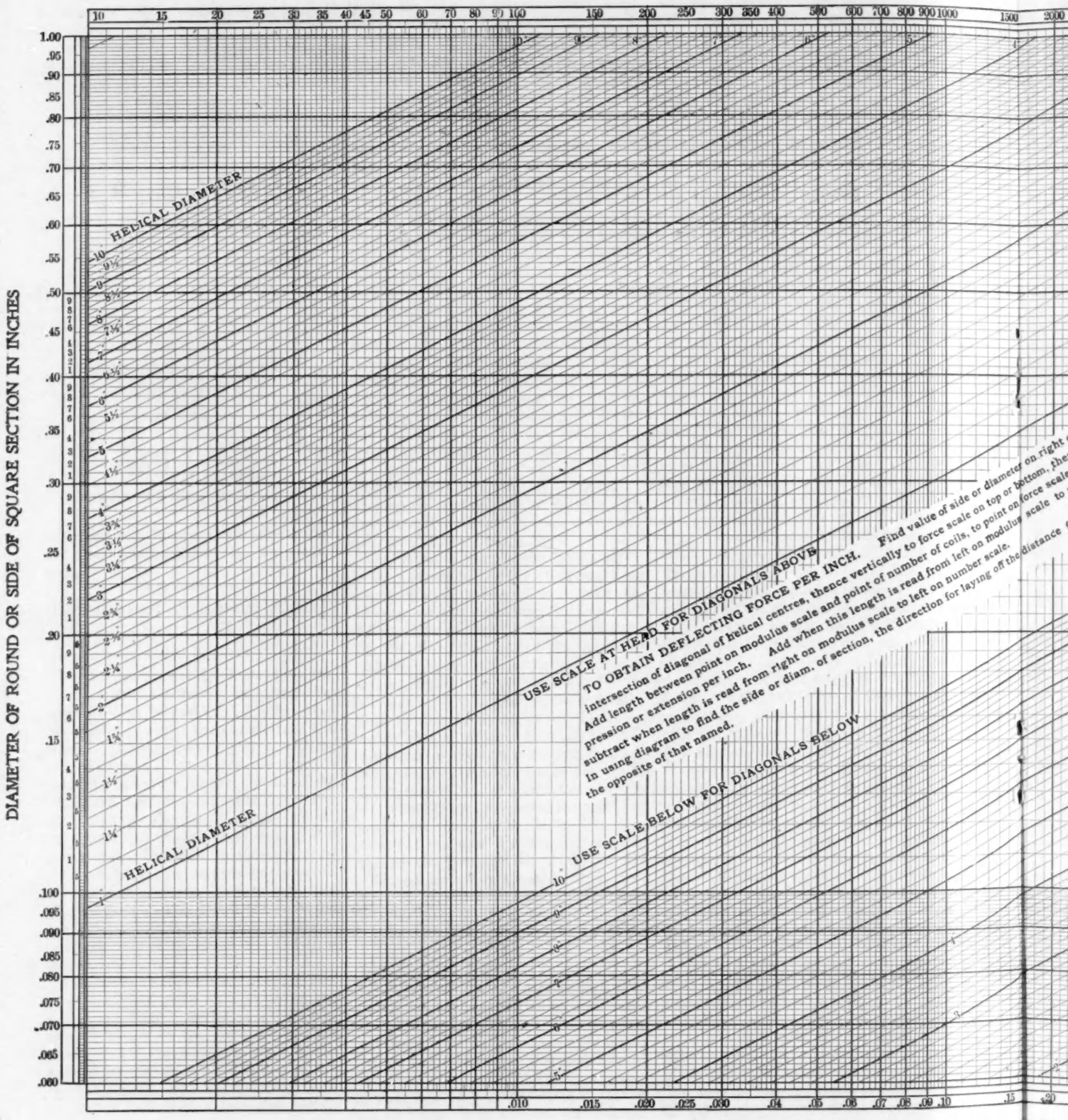
In using the diagram for a spring of round wire and any number of coils, or for square section and any other than nineteen coils, the reduction scale must be used. In finding W_1 the method of procedure is as follows: In the first place find W_1, as in the preceding case; next find a point on the top or bottom scale higher or lower on the scale and at a distance from the point so found, equal to the distance on the reduction scale between the value of modulus of rigidity and the number of effective coils. This distance may be transferred by dividers or by a marked strip of paper, and, since the force to deflect the spring a given amount is less the more coils there are, and greater, the greater the modulus of rigidity, the following rule holds good as to which direction the transferred distance is to be laid off on the top or bottom scale: If the point on the modulus scale lies to the right of the point on scale of number of coils, the distance transferred is used to diminish W_1; but if the point on the modulus scale lies to left of the point indicating the required number of coils, then the transferred distance is used to increase the value of W_1.

One example will suffice: A spring is to be made of forty coils of square steel, whose side measurement is ½ inch, the diameter of the coil being 6 inches, and the modulus of rigidity being 11,000,000. To find W_1: Find .50 on the left-hand scale and trace horizontally to the diagonal marked 6 inches; thence trace vertically and read 33 pounds on the top scale. Now turning to the reduction scale for square section, measure from 40 on scale of number of coils to 11,000,000 on modulus scale, and transfer this distance so as to diminish W. It will be found that the new point is 14.3. Supposing the point lies outside the limits of the scale—i e., suppose that the new W_1 is less than 10—measure the distance from 10 to the new point and set off this distance from 100, so as to give a new reading, W_1^1; then since we must divide by 10 on account of this transfer of position on the scale, the value of W_1 is found to be $\frac{W_1{}^1}{10}$ pounds. This takes some time to describe, but in reality the process is almost instantaneous. The operator takes a strip of paper and laying it on the reduction scale makes two marks, A and B, so that A lies on 40 and B on 11,000,000. This strip of paper is then laid on the top scale so that B lies on the point 33 (already found), and opposite A is found the value of W_1, viz., 14.5. Suppose A had lain so as to be off the scale (beyond 10), then a point C is marked on the paper strip, and then the distance $A\,C$ is used to find the final reading, by shifting the strip and putting C opposite 100, and finding A opposite the new number registered, which is read as 1-10 the value found. The reader who is well acquainted with the slide rule may use his own common sense in applying this method, as he will readily recognize the principles upon which the reduction scale and the diagram are based. The whole function of the reduction scale is to find by the addition or subtraction of a distance, a proportionate sum.

The diagram, with the aid of the reduction scales, can be equally well used to find the dimensions of a spring. The reader who has sufficiently followed this process will easily see how this can be done, but a word of caution is necessary. In finding the dimensions of section for a given load W_1, W_1 is first found, and then the reduction scale is used to find a new point on the scale, and this point is treated as the new load, and the dimension d, whether for round or square section, is found in the manner already described in a previous case. The only difficulty is, to know on which side of the original load the new point should be. This question is very readily answered by remembering that the diagram as it stands serves only for a square spring of nineteen coils. If, therefore, the number of coils is increased, the dimension d must be increased, since with an increased number of coils, a relatively larger section is required in order that the same deflecting force may still alter the length by 1 inch. On the other hand, an increase of the modulus means a stiffer spring, and the diameter can consequently be decreased. Hence the rule for transference of the distance found on the reduction scale, to the scale of loads, is the reverse of that used when the deflecting force per inch is to be found. One example may serve to make this clear: Number of coils = 15, helical diameter = 5 inches, deflecting force per inch = W_1 = 60, modulus of rigidity = 11,500,000. Find the side of a square section spring. Here the strip of paper is applied to the reduction scale for square sections, and a point A is marked on the paper opposite 15, and another, B, opposite 11,500,000. This strip is now shifted and applied to the top scale, so that A is applied to 60 and B is opposite the new point. From this point a line is traced vertically downwards till the 5-inch diagonal is met, and from the point of intersection a horizontal line would cut the vertical scale at the point .48, which is the side of the square required.

As the most general method followed is to assume d, D and N, and make n the number of coils of the spring to suit the given deflecting force W_1, it may be as well to point out how this may be done by the aid of the diagram: Find in the ordinary way the load by following horizontally from the valve of d to the diagonal marked D, and thence vertically to the scale of loads. Measure on a strip of paper the distance from the point so found to W_1 on the same scale; apply the strip of

FORCE PER INCH EXTENSION OR COMPRESSION. 19 COILS SQUARE SECTION AND
USE REDUCTION SCALE FOR OTHER VALUES.


DIAMETER OF ROUND OR SIDE OF SQUARE SECTION IN INCHES
HELICAL DIAMETER
HELICAL DIAMETER
USE SCALE AT HEAD FOR DIAGONALS ABOVE
USE SCALE BELOW FOR DIAGONALS BELOW
TO OBTAIN DEFLECTING FORCE PER INCH. Find value of side or diameter on right
intersection of diagonal of helical centres, thence vertically to force scale on top or bottom, the
Add length between point on modulus scale and point of number of coils, to point on force scale
pression or extension per inch. Add when this length is read from left on modulus scale to
subtract when length is read from right on modulus scale to left on number scale.
In using diagram to find the side or diam. of section, the direction for laying off the distance
the opposite of that named.

FORCE IN POUNDS REQUIRED TO DEFLECT SPRING ONE

DEFLECTION OF CYLINDRICAL SPIRAL SPRING

ECTION AND MODULUS OF RIGIDITY 12,000,000
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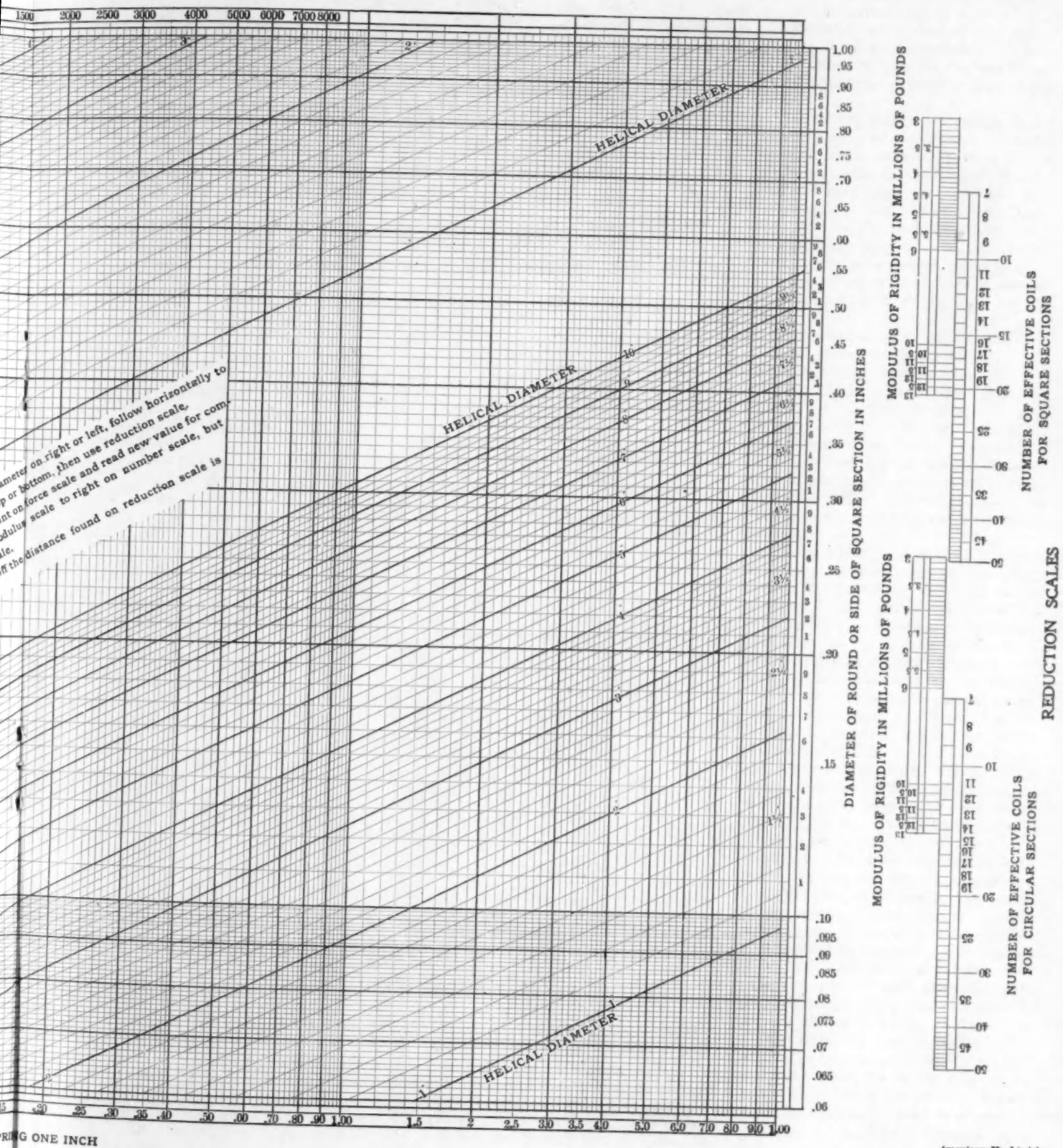
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DIAMETER OF ROUND OR SIDE OF SQUARE SECTION IN INCHES
MODULUS OF RIGIDITY IN MILLIONS OF POUNDS
NUMBER OF EFFECTIVE COILS
FOR SQUARE SECTIONS
MODULUS OF RIGIDITY IN MILLIONS OF POUNDS
NUMBER OF EFFECTIVE COILS
FOR CIRCULAR SECTIONS
REDUCTION SCALES

RING ONE INCH

L SPRINGS

American Machinist

marked paper to the reduction scale, so that one mark coincides with the value of the modulus selected, then the other mark will fall opposite the required number of coils.

New Brompton, Kent, England.

Cast Iron Dies.

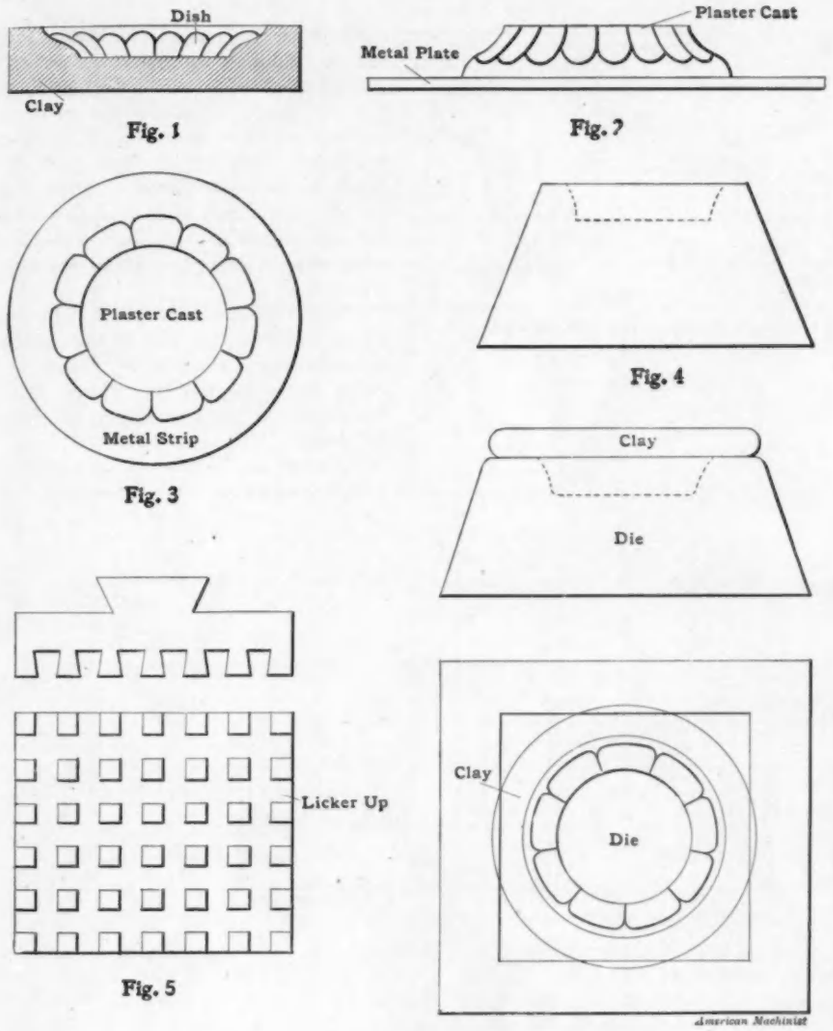
BY R. I. CLEGG.

Many who, like myself, have had the task of cutting steel tools for sheet-metal work, must have longed for a reverse process to the one described in a recent number of the "American Machinist"; where, it will be remembered, an up-to-date molder got out a fine, clear cast-iron copy of a souvenir medal—in short, instead of cutting a hob or die directly out of the solid steel, to use a pattern of wood, wax or plaster, and cast the tools.

To a certain extent this is done very successfully, and being aware that the process is not any too well known, I send the following particulars, gleaned from shops where such dies are in daily use.

These shops, by the way, manufacture sterling silver ware, and it is noteworthy that the shop that sends out punch-bowls for battleships spends less on the simpler dies than another shop making water and lard pails, tin cans and the like. To be sure, this is due largely to the profuse variety fashion demands in articles of the precious metals as compared with zinc, tin and sheet-iron goods, where the immense quantity supplied at a narrow profit implies more uniform styles and shapes.

A shop of the latter kind makes a pail in which the thin base is strengthened by a series of corrugations radiating from the center like the spokes of a wheel.



MAKING CAST IRON DIES.

My attention was called to the die which puts in the flutes, and certainly it was a remarkable job. The shop does have a drill press and a couple of lathes—only this and nothing more; the die, therefore, was an exhibition of cold-chisel planing. I took it for granted that a "force" was used in connection with the die, but have since had a suspicion that, perhaps, that convenience might not have been in vogue there. If the die was carved out by the cold chisel, the two halves complete, I know of no tougher task, provided the time is limited. Such plain, straight work is easily milled; but first catch your milling machine, and, lacking that, you must go back to more primitive methods.

Information as to shop practice among jewelry firms and silversmiths is, as a rule, difficult to get; the Gorham Manufacturing Company, however, state as follows:

"We do use many cast-iron dies in our business, and find the metal very useful, enabling us to make inexpensive dies to produce articles having general features that are quite plain, or that have little ornamentation, and that of a soft character. But for the manufacture of spoons forks or other articles to receive a higher state of ornament, where great force or pressure is required to produce the results, cast iron is totally unfit for the duty."

Ornamentation of a soft character obviously means but slightly raised, or low relief, and without sharp lines.

The J. B. & S. M. Knowles Company, makers of sterling silverware, through the treasurer, Mr. Burwell, inform me that: "We use cast-iron dies quite largely for dishes from 3 to 12 inches in diameter. The largest dish we make is about 12 by 16 inches. This dish weighs about 24 ounces, and is gotten up with a 600-pound hammer."

Although familiar with dies in a general way, the writer has never made a pattern for a cast-iron die, and the description I shall give of the method has been provided by an expert silver worker. Cast-iron dies for stocking up silver hollow ware are made about as follows, or at least this is an easy way to make them:

Hunt up a lot of crockery catalogs and find the dish shapes you want. You will be able to secure a loan of the dishes. Take the dish and surround it with clay, pressing the dish down into it. Build your clay up a very little higher than the dish edge, and flare to prevent undercutting (Fig. 1). Pour into the dish, as into a mold, plaster of paris, and let it stand until set. Now with an old knife and rough rasp smooth off the bottom—i. e., the part uppermost after pouring. Before you do this, however, it would be wise to take out the cast, otherwise there is danger of breaking your original model. Now find level bench with true metal plate, and upon the metal plate place your cast, which has been nicely shellacked to prevent sticking (Fig. 2). Take a strip of sheet metal and make a shallow tunnel of it, large enough to surround your cast, and leave from 1½ inches upwards of leeway, as in Fig. 3. Tie a string around the rolled-up sheet metal. Now pour in your plaster; the amount depends upon the size of your dish; this is determined, of course, by experience. When the plaster is fairly hard, untie the string and take off the metal band or tunnel and smooth off your new cast bottom; turn it over with first cast still in place, and trim

it up to suit your idea of how little iron is necessary, making the base larger than the top, etc. Some men are very skillful in this line, and will take out their casts when about the consistency of cheese and whittle and carve away in a remarkable manner.

The thing when nearly ready looks like Fig. 4. Brown & Sharpe do the casting and chill the top, which is now sent to the die cutter to be finished and polished, and often ornamented upon the rim.

Of course nice ware is touched up very often after being struck. I am told that Gorham makes teapots in this way one-half at a time.

Now in regard to the "force," all you have to do is to fasten a slotted piece of iron in hammer of drop—known as a "licker-up"—(Fig. 5), and, after putting your cast-iron die on the bed of the drop, roll up a lump of clay until it looks like an eel; oil it, and place it as in Fig. 6.

Now pour in your melted lead and tin mixture. When set, but hot, take away your clay eel and bring down your hammer. The "licker-up" will pick up the lead "force," and one or two raps of the hammer will shape the lead well into the die.

In regard to striking the ware, it is of advantage to force one or two pieces of sheet brass into the die in order that the stock may not be cut in the first few strokes. The work will require frequent scraping (to take off bits of lead) and annealing before it is down to the brass. Now take out one of the brasses; strike medium blow. Scrape, anneal, look over and "pickle." Take out last brass, bring down "force" by one or two good raps, carefully wipe out die and strike again. If not up, anneal, pickle and strike again. This kind of work requires frequent annealing, varying according to depth of die.

The "force" mentioned above is of the softer kind. Sometimes "forces" are required much harder, and are cast of various bronze mixtures to fit the job in hand. For some purposes, as in the manufacture of jewelry and metal novelties—hand or foot press work—the "licker-up" is dispensed with, and the force is cast with a tenon, which is turned to fit the socket of the press.

Probably the cast-iron die may not displace the steel die beyond a very limited extent; but I am sure the description of its use and capacity, the molding and pattern making incidental to getting out the die and tools, will be novel, if not indeed very useful, to many readers of the "American Machinist."

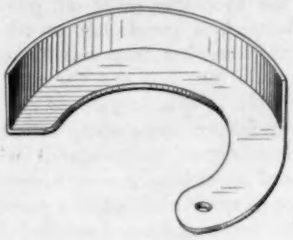


Fig. 1

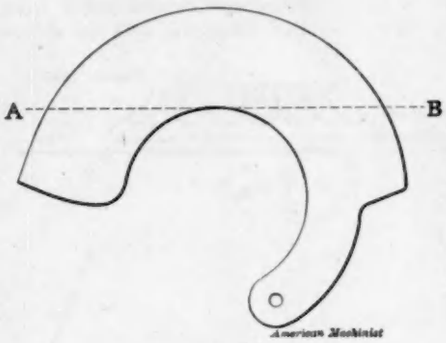


Fig. 2

FINISHED PIECE AND BLANK.

A One-sided Job of Drawing.

BY W. A. WARMAN.

Not long ago a piece like sketch Fig. 1 fell to the lot of the writer to make. It proved itself no "cinch." The sketch Fig. 3 shows partial section of the punch and die with which it was made. *B* is the die, 1½ inches deep, let into bed *A*. *C* is a punch, or sleeve, threaded on guide punch *D*. The lower part of *D* is made to fit the die, and necked in at *L* to allow the blank to be slipped into place when sleeve *C* is screwed up.

F and *G* are the members of a slip joint, fitting into the ram and giving sufficient lost motion to prevent the flange on *D* rising above the top of the die. *H* is a holding-down plate necessary to prevent wrinkling.

H swings on the screw I^2, and is slotted to swing under I. The centers of *I* and I^2 should be on a line A B, shown through the blank in Fig. 2.

Four pins, as shown at *K K*, were found convenient for working the sleeve *C*, but you want to have a piece of pipe ready to give her a final yank. The die should be good and hard, and polished in the direction of the draw.

C and *D* need not be hardened, but *C*

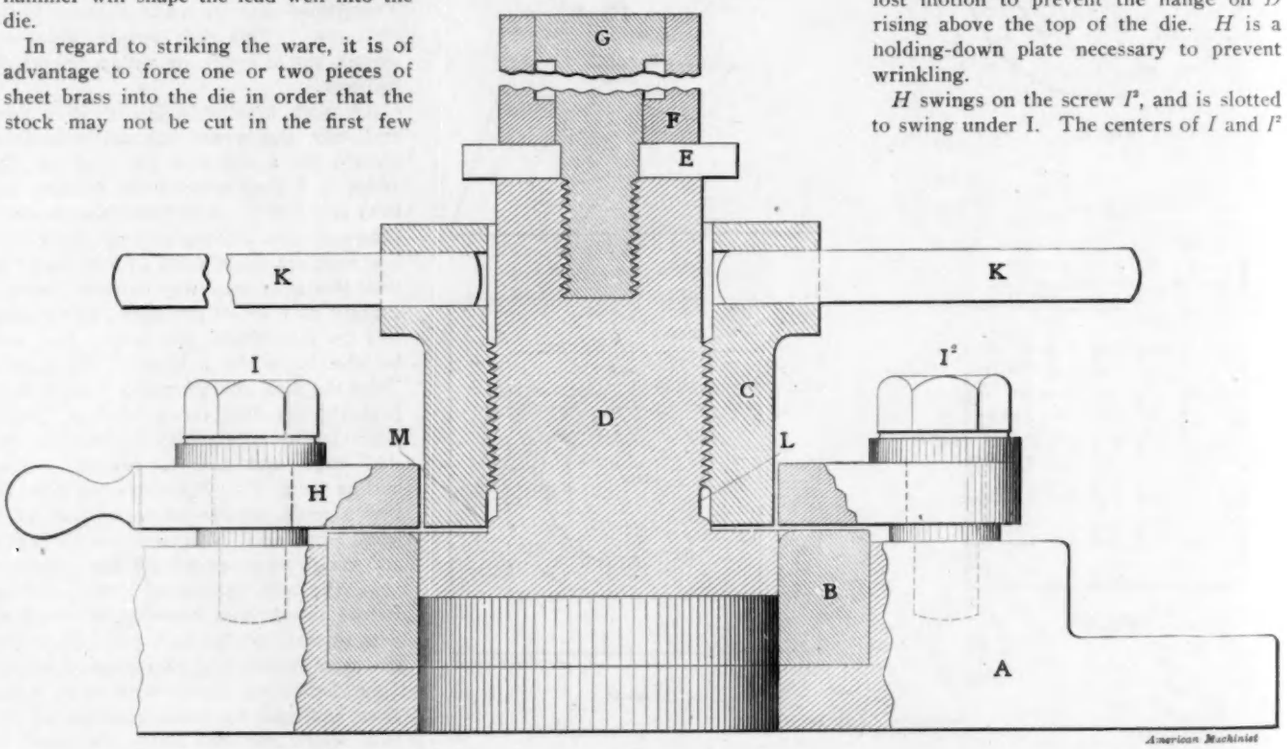


Fig. 3

DRAWING DIE FOR ONE-SIDED OPERATION.

must have a piece of steel dovetailed into it at the back and hardened. The dovetailed piece, after hardening, must be ground, allowing it to project the thickness of the stock to be drawn. This is not shown in sketch, but a piece 1½ inches wide was found ample. Without this, *C* will spring away from the work. Do not try a coarser pitch screw than 10 on *D*; it won't hold the job. We commenced with a 4 pitch and wound up on 10.

The blanking die is just a plain everyday one. The operation of the drawing or forming die is as follows: Raise the sleeve *C* enough to allow the blank to be slipped over *D* and *L*. Drop it over *M* on to the flange, then screw *C* down to clamp the blank; swing *H* to place, and let her go.

An Engine Builder's Practice in Making Force Fits.

BY HENRY HESS.

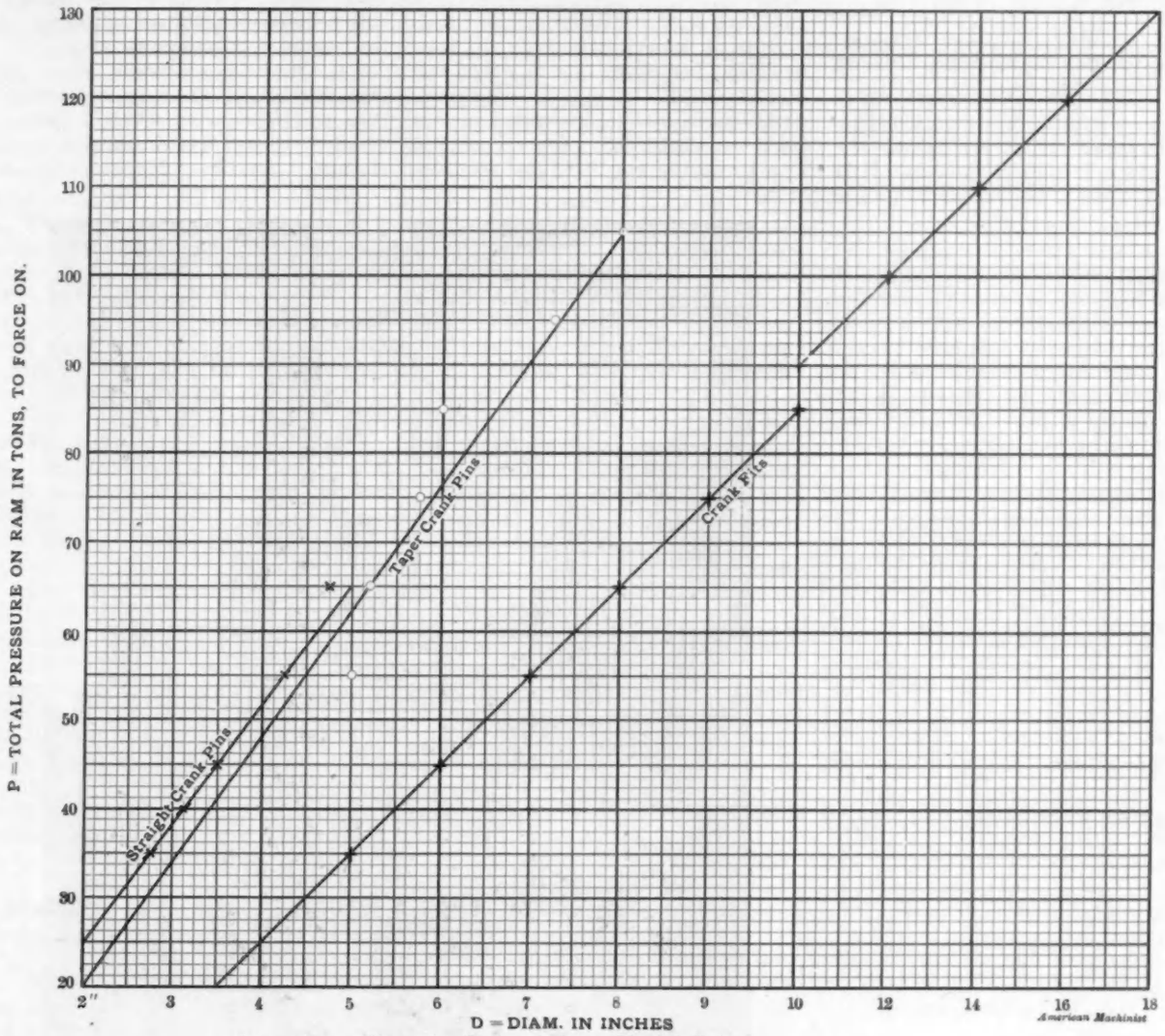
While going through the shops of a prominent Ohio engine-building concern not long ago, I noticed some cranks being forced on under hydraulic pressure. Seeing my manifest interest, they very courteously placed at my disposal a statement of their practice; this I have plotted in the accompanying diagram. *X* denotes their practice for straight crank pins; *O* denotes their practice for taper crank pins; + denotes their practice for crank fits.

With nearly all of these the various points fall on straight lines. The chief deviation, as was to be expected, is with the taper pins, where a very small difference in fitting amounts to a considerable variation of the forcing allowance. Note the break in the crank-fit line due to a change above 10 inches. The formula changes not only in the adding constant, but also in the multiplier. At first sight this is not apparent, as the direction of the line does not change; but this is only apparently so, as, in order to reduce the size of the diagram, the diameter scale is changed above 10 inches.

Naturally the force stated as required is not exact; the foreman superintending the operation says that it will vary 5 or 10 tons either way of the amounts given.

Of course, the force stated is the maximum used just as the parts get home.

At first sight one might be led to as-



Approximate Formulæ Deduced from Plotted Points.

Crank fits $P = 9.9\,D - 14$ up to $D = 10''$.
Crank fits $P = 5\,D + 40$ from $D = 12''$ to $24''$.
Straight crank pins $P = 13\,D$.
Taper crank pins $P = 14\,D - 7$.

For cranks and straight pins allow .0025″ per inch of diameter. Taper crank pins are fitted on the lathe to within ⅛″ of shoulder and then forced home. Taper 1-16″ per inch.

PRESS FITS.

sume that the holding force resisting separation would be the same as this final assembling force, but this is not so; an analysis of the tests cited by Prof. Wilmore in a recent article shows this to be less.

[The difference between the forces necessary to press home shafts and crank pins of the same size is apparently due to the difference in length.—Ed.]

Double-Spindle Boiler-Shell Drilling Machine.

The accompanying half-tone illustrates a new style of boiler-shell drilling machine, which is a recent product of the shops of Thomas H. Dallett & Co., of Philadelphia.

The general arrangement of the machine with respect to its method of attacking the work will be apparent from the picture. For the successive holes in the girth seams the boiler shell is turned over on the supporting rollers, while for the longitudinal seams the machine is adjusted lengthwise of its bed. Two drill spindles will be seen, the supporting castings for which are independent and may be adjusted on the circumference of the motor shell by the small pinions in the center of the length of the shell—only one of which is seen—until they are the right distance apart. These pinions being then locked from further turning, the long crank, seen above, acting through the central ring gear, swings both spindles around the shell until the desired inclination of the line joining the two holes is obtained, when suitable binding bolts lock all in position. The entire operating mechanism is also capable of swinging about a stud, perpendicular to the face of the post, so that holes may be drilled at any angle between the perpendicular and forty-five degrees above the horizontal. Independent adjustable automatic feeds are provided for the spindles, as well as a quick-action hand feed through the light gear in the rear, through which the spindles may be advanced separately or together.

The motor being of the enclosed multipolar type, is well protected from injury. The starting box and back gears used in combination give ten different speeds, and a reverse motion provides for the use of the machine in tapping staybolt holes. An automatic circuit breaker guards against overloads.

The arrangement of operating levers will be seen to be very convenient. The one which adjusts the machine lengthwise of the bed has two pawls which engage with oppositely facing ratchets, and the direction of motion is changed by reversing these pawls. This adjustment of the machine is facilitated by the provision of roller bearings between the post and the bed. The vertically moving parts are counter-weighted, and a capacious reservoir for lubricant will be noticed.

The range of vertical adjustment is 4 feet 6 inches, the spindles in the highest position being 7 feet above the base. The spindles are fitted with No. 4 Morse taper sockets, and the range of adjustment between centers of spindles is from 4 to 17 inches.

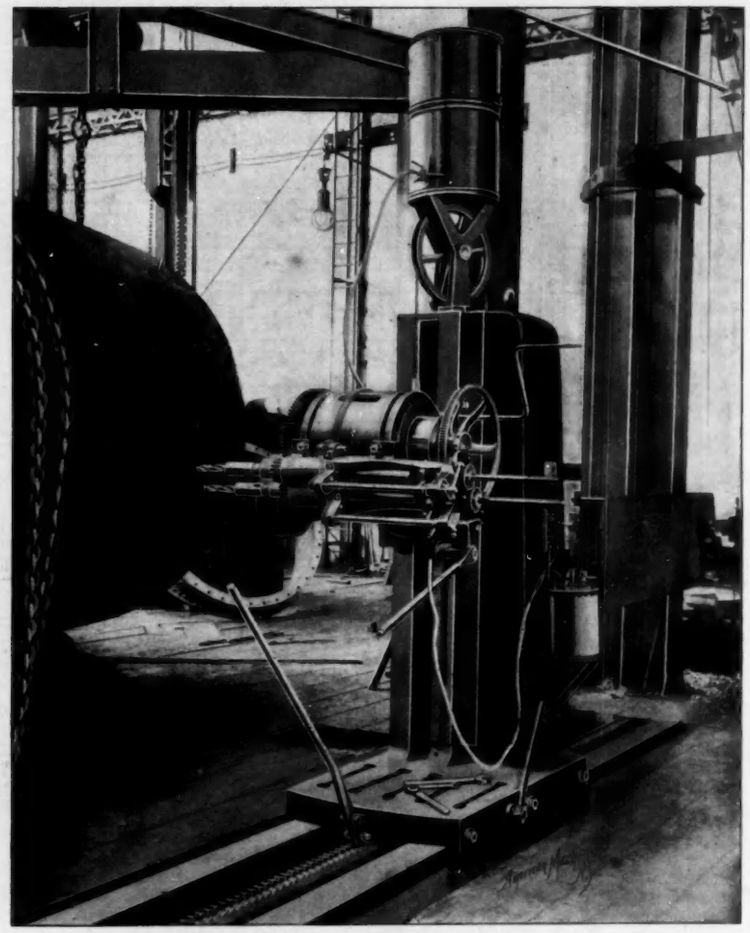
Light Brass Founding.

BY C. VICKERS.

When I learned the trade of brass founding I served my time in a shop that was connected with a large engineering establishment, and so the work was what might be called heavy. When I left that shop I naturally gravitated towards shops producing a similar line of work; and so for a number of years that was the only class of brass work in which I had experience. I acquired a kind of contempt for small work, and disparagingly called it "chicken feed." There came a time when I became connected with an establishment which had to make considerable quantities of that chicken feed in order to get the heavier class of work they wished to make their specialty. Then I discovered I had much to learn before I knew my trade thoroughly. Other people were turning out that class of work at prices and of a quality we could not imitate; so our customers were anything but satisfied. The castings we were making were too rough and were devoid of that nice orange color they should have had. We put good metal into them, but on account of the color our customers would not believe it, for in this case appearances are everything. The consequence was that our light work left us, a thing that we deplored only because we could not get enough of the heavier work to keep us busy.

We ultimately, of course, solved the problem; but in doing so I discovered that the light work which I had so despised required knowledge of a special character, and that the materials and methods employed on heavy work were unsuited to the production of fine light castings.

As might be expected, the sand is the most important factor in the case. When sand of a coarse grade is used in the molds the grains, being large, do not pack close together, but leave small interstices between, into which the metal enters, giving the castings a coarse, file-like surface, which is not particularly noticeable on large castings, but shows up bad on small ones. In shops where all the work is of a heavy character it would scarcely pay to give



DOUBLE-SPINDLE BOILER-SHELL DRILLING MACHINE.

shop room to a fine grade of sand, as it would only be used occasionally, when such work as name plates had to be made. These castings, however, can be turned out very nice and smooth in the coarse sand, by using a facing composed of equal parts old and new sand, to every twenty parts of which one part of flour is added. This facing, however, cannot be expected to take the place of the specially prepared fine sand on all-round light work. This class of sand can be procured from any of the dealers in foundry sands. It is often called "brass" sand, and in the Western country a great deal of it comes from around Zanesville, Ohio.

Another important item is, of course, the shop equipment, such as flasks, boards, etc. The flasks ought to be interchangeable, and the pins should fit perfectly, as, if there is any shifting it is almost impossible to obtain a good "lift," and this is indispensable to good work. Plenty of boards should be provided, as they are used on the cope, as well as under the nowel. The cleats on these boards are in many brass foundries nailed across the ends, the same as on a drawing board. They can then be used indifferently on cope or nowel. The absence of the usual cleats makes it better in "weighting up," as the weight will rest flat on the board wherever placed.

Suppose we have got a "side" of loose, light jobbing work and we are going to commence molding. In arranging our patterns on the match, or follow board, as the case may be, we place the lightest ones at the end of the flask, farthest from the sprue, and the heavier ones near the sprue, because, the flask being inclined while pouring, the metal rushes down the runner and fills the vacancies at the bottom first. Another important thing in placing the patterns is to arrange them so that they can be gated at the end that is nearest the sprue, as this is the highest point of the casting when the mold is elevated, so the metal runs down hill all the time that it is filling the mold. The practice of using boards on the cope is not followed in all foundries. In such cases a perfectly true and smooth board is bedded on each cope before it is lifted off, and the weights used to hold down the same when pouring are wide enough to reach across the flask, and should be flat, so as to have a bearing on the sand. This practice, of course, saves one-half the boards that would otherwise be necessary, and is satisfactory, provided the smooth boards and the weights are true. If the board is warped and is bedded on the copes in that condition, the weights will bear too much on some places and not at all on others, and some of the castings will be strained and others will not "run," simply because in the one case the pressure of the metal will force up that part of the mold where the weight does not touch, and in the other the weight will press down that part of the mold on which it bears too heavy; so that, all things considered, I prefer the use of boards on the cope for very light castings, because each mold, having its own board properly bedded on while the patterns are in, and the same board being kept on during casting, the chances of loss from the causes above mentioned are reduced to a minimum.

Castings may be strained from other causes than the ones just mentioned. The upward pressure exerted against the cope by the metal at the moment of pouring is very great, and few foundries have their weights heavy enough to resist this pressure, and if we place on more than one weight their hight will interfere with the proper pouring of such molds, as they are almost universally poured with the "side tongs," the lip of the pot being rested on the edge of the flask. The office of the weight in this case is rather to hold down the cope after it is poured, and not while being poured; the foot of the molder performs the latter service. If we watch a molder pouring off we will notice that he does not remove his foot immediately after filling a mold, but lets it linger there until he has commenced pouring the next mold, and so makes sure that the pressure has been so diminished by solidification that the weight will be sufficient. Failure in this particular will also result in strained castings, and will swell the scrap pile, as no fire is permitted on light work.

Fine sand will produce fine castings, and it is surprising what beautiful work can be made when we are provided with this most important requisite; but even fine sand will adhere to patterns if something is not used to prevent it. The best thing that can be obtained for this purpose is lycopodium, an impalpable yellow powder, obtained from the clubmoss. It is expensive, but it pays to use it, and some foundries running all fine work use nothing else for parting. Others, again, think it is too expensive a thing to be used in a foundry, and generally it will be found that these people are so ignorant of the practical part of their business that they never discover they are throwing away dollars to save cents.

So we have fine sand and also lycopodium, and now we want fine metal—that is, metal that will "color" well. Here is a recipe for such a mixture: Copper, 16 pounds, and a pound each of zinc, tin and lead. This is called ounce metal, because there is used an ounce each of the three metals to a pound of copper. For extra fine castings we can decrease the lead and zinc by one-fourth.

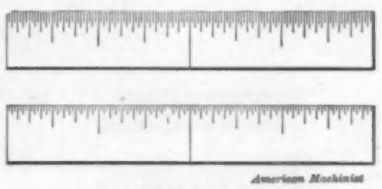
The class of work we have been considering is supposed to be very light and fine, and if the materials, methods and metal are as suggested, and the castings are allowed to cool in the molds, they ought to come out both smooth and with that nice color which, as before mentioned, is so desirable.

Letters from Practical Men

Scale Graduations.

Editor American Machinist:

Not long ago I saw a fellow squinting through an eyeglass at the fine divisions—sixty-fourths of an inch—on his steel scale to determine a certain dimension.



A SCALE KINK.

His actions reminded me of a kink that I picked up in my travels. It was simply to grind or plane off the edge of the scale, originally like Fig. 1, until it was like Fig. 2. The shorter marks are much more easily read, as a glance at the figures will show. R. B. COCHRANE.

Some Shop Notes—Boring a Taper.

Editor American Machinist:

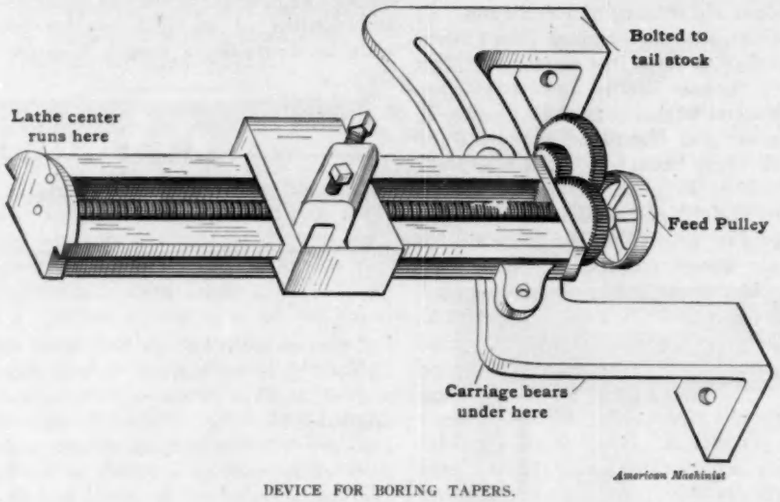
I was looking around a small shop recently, while the proprietor was out in the foundry with all hands but one "pouring off." It was one of those india-rubber, universal shops that can swallow anything, and, as the "jour." who did not have to help pour off remarked, it was "a good place to study applied mechanics." His conversation was a little jerky, because the crowbar with which he was propelling the lathe carriage occasionally slipped out of the holes in the floor, and when I perceived that there was no handwheel or substitute for one, on that carriage, with which to move it, I agreed with him that applied mechanics could be used there to good advantage. Then I thought of a mechanic in another shop, who made a good deal of fuss because his lathe (which was a good modern tool) would vary a quarter of a thousandth in turning a 3-foot shaft, unless he watched it, and I wondered how he would make out in this shop if he had to do a good job with these tools; and I noticed some good work was being done in spite of the tools.

On the same lathe I saw an attachment of which I send you a sketch. In this shop they had a good many pieces in which to bore large taper holes; this rig would bore holes as small as 4 inches of any depth up to 2 feet. It consisted of a narrow slide rest which is supported at the head end by the lathe center, and at the back end is bolted to a curved, slotted, angle casting attached to the tail stock. The adjustment for taper is of course made in the curved slot.

The feed pulley shown in sketch runs loose on the screw, and carries a small

pinion which meshes into the gear at the back. This feed pulley is driven by a small pulley overhead.

For some work this makes an excellent tool, although for general work perhaps the part carrying the tool might be made round and gotten into less space for small



DEVICE FOR BORING TAPERS.

holes. You will notice that the tool-block has a set-screw on top of the tool, and one behind it to feed it out. T. B.

The Charging of Air Chambers and Pressure Tanks.

Editor American Machinist:

In the "American Machinist" of March 30 appeared a very interesting article by Mr. Walter Ferris, in which he describes an ingenious arrangement for charging air into pump air chambers and elevator pressure tanks. While the results secured by this device are undoubtedly good, I believe that the same object may be attained by much simpler means. The apparatus which I have used consists merely of a short pipe screwed into the wall of the cylinder so as to communicate directly with the pulsation chamber of the pump. This short pipe is provided with a gate or globe valve and a check valve of any approved form. The check valve is set so as to open inward, and is best located at the outside end.

Using the same pump as was shown in the article referred to, I should arrange the air-charging apparatus as shown in Fig. 1. In the more usual forms of piston and plunger pumps I prefer to make the pipe connections as close as possible under the discharge valves, as shown in Fig. 2, thus affording the most direct outlet for the air, and utilizing the total suction head for the introduction of air into the cylinder. In both figures *A* is the short pipe, *B* is the globe or gate valve and *C* is the check valve. The pipe *A* should be slightly inclined downward from the pump to avoid forming an air pocket when it is not in use as a part of the charging apparatus.

To charge the air chamber or tank it is necessary only to open the gate valve *A* slightly, to allow air to be drawn in through the check valve *C*. On the discharge stroke the air will be forced through the discharge valves of the pump and will crowd against the upper surfaces of the water passages, and in so doing will naturally find its way directly into the air chamber or tank. I prefer in most cases to admit the air very slowly, so that it will constitute but a small percentage of the total piston displacement while the pump is performing its regular work. This requires no special care on the part of the engineer, and the resulting unsteadiness in the running of the pump will be almost, if not quite, imperceptible. In case the water flows to the pump by gravity, it is necessary to throttle the intake somewhat while the air is being pumped. Many engineers make the mistake of connecting such a pipe below the suction valves, in which case the normal action of the pump is entirely suspended during the charging process. When this is done the air must be pumped to the proper level at stated intervals, usually before the regular work begins, certainly a troublesome and useless task for the engineer.

Where the pressure on the air chamber is continuous, and air cannot enter the discharge pipe at frequent intervals, the air chamber should always be provided with a gage glass, so that the hight of the water in the air chamber can be readily observed. It is pleasing to note that there is an increasing demand for such gage glasses on the smaller sizes of pumps.

Cast iron under high pressure proves to be a porous material, and for this reason a copper air chamber will retain its air longer, the only loss being through the water. When cast iron is used for high pressure chambers it should be thoroughly painted inside with asphaltum or other similar compound to reduce its porosity. In many cases I prefer the horizontal form of air chamber, as it is much less liable to vibration on account of its lower center of gravity, and the less differences of water level which occur. However, a horizontal chamber will lose its air much more rapidly than the regular vertical pattern, on account of the greater water surface exposed. In most cases where an air chamber is necessary its capacity should not be less than 3 per cent. of the per minute capacity of the pump.

FRED B. COREY.

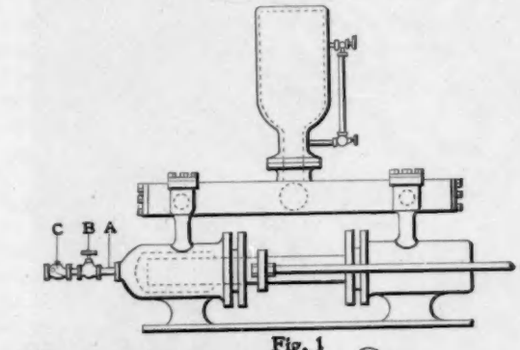


Fig. 1

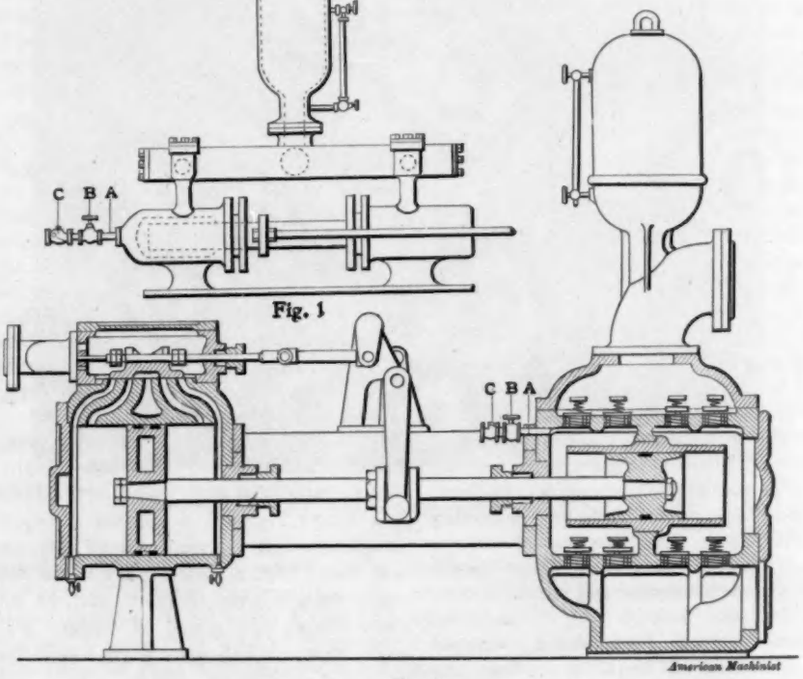


Fig. 2

CHARGING AIR CHAMBERS.

Drawing Hexagon Nuts.

Editor American Machinist:

Mr. Morris Fulton, in your issue of March 16, suggests a method of drawing hexagon nuts which seems to me most unnecessarily complicated, to say nothing of the diagram which has to be made in the first instance, and which, when made, is one of those things which are seldom conveniently at hand when most wanted. Moreover, I am afraid Mr. Fulton will not find many draftsmen enamored of the product of his labor, as exemplified by the drawing of the hexagon nut shown on page 216. This, however, is not so much a matter of opinion as of investigation, and I think in what follows I shall not experience much difficulty in showing that not only is it easily possible to construct a more shapely nut than Mr. Fulton's, but also that the method of doing this is considerably simpler than that suggested by your correspondent.

Let us first investigate the actual curves for which we substitute circular arcs, as in this way we shall be better able to see what is aimed at, and therefore also better able to fill the bill.

With this end in view, we draw, in Fig. 1, the half plan *a b c e* of a hexagon nut for a bolt of diameter $D = g f$. From the center O, with radius $= D$, we draw the circumscribing circle as shown, and from the same center we draw the inscribed circle tangent to *a b*. From the point *h*, in which the latter circle meets the base of the nut, we raise the perpendicular *h k*, and from *k* we draw *k m* at the usual angle, 45 degrees, with the upper face of the nut. Drawing the horizontal *m n*, it is at once seen that we require to determine the intersection of the conic frustum *m k p n* by the three vertical planes shown in plan by the lines *a b*, *b c*, *f c e*. Confining our attention to the center one of these, we take a series of horizontal cutting planes through the conic frustum, these being indicated by the circular arcs 2, 3, etc., in plan, and the horizontals 2′, 3′. etc., in elevation. From the points 2″, 3″, etc., in which the former cut *b*1 in plan, perpendiculars are raised cutting the corresponding horizontals in a series of points through which the curve *r t* is drawn. There is no need to repeat this construction in order to determine the curve *m q r*, as the necessary foreshortening can be effected very readily by setting off, on either side of *q i*, lengths equal to one-half the corresponding lengths used in determining the main curve. Thus $i r = \frac{1}{2} r7'$, and, setting off the remainder of the lengths, we are furnished with the necessary points through which the curve *m q r* can be drawn.

My method of drawing circular arcs as substitutes for these actual curves is shown on the other side of the nut, and I think it will be conceded that all practical requirements are fully met by the simple construction which I adopt. The unit employed is *d*, the difference of the radii of the circumscribed and inscribed circles, and the method of procedure is as follows: From the center *O* with radius *D* (= diameter of bolt) draw the semicircle *a i e*, giving the center curve, the points *a* and *e* for the outer lines of the nut, and also the point *r* from which *m n* are obtained; through these the bevel lines *p n* and *m k* are drawn. Drawing the smaller curves with a radius $= 2d$ completes the nut. The bolt should show through the nut somewhat, and $\frac{1}{2}d$ seems a convenient amount to allow. The top of the bolt can be struck with a radius $=$ D from center *y*.

One of the advantages of this construction is seen when, as is frequently necessary, the other view of the nut (shown in Fig. 2) has to be drawn. In this case the hight of the nut and of the bolt end is drawn as before, while *f t* in Fig. 1 gives the length *f′ t′* to set off on each side of the center line, in order to show the width of the nut across the flats. The actual curve on the left is derived from the main curve by setting off *b s* (in Fig. 1) at right

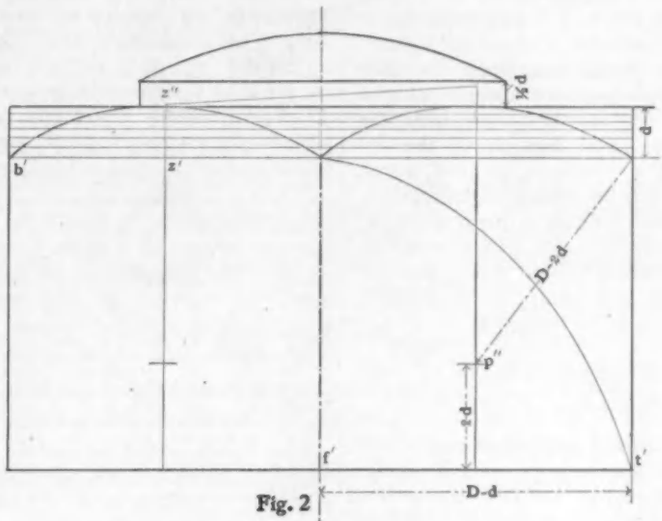


Fig. 2

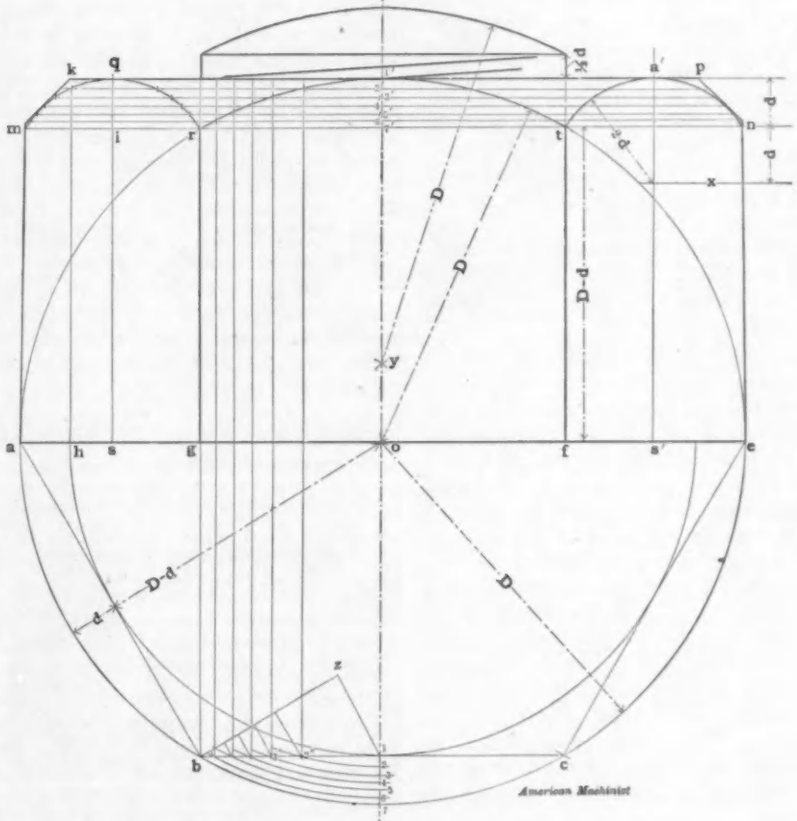


Fig. 1

DRAWING HEXAGON NUTS.

angles to $a\,b$ and projecting on to this the several points 2″, 3″, etc. The lengths so obtained are set off on each side of $z'\,z''$. Thus, $b'\,z' = b\,z$, etc. My method of drawing an almost exact circular equivalent is shown on the right hand, the center p' being $2\,d$ $(= x\,q')$ from the base of the nut, and the radius $(D—2d)$ being therefore $= s'\,x$ in Fig. 2.

I do not think it is likely that this method can be improved upon in point of simplicity, and a comparison with the actual curves shows how closely the circular arcs approximate to the actual curves. It may be thought supererogatory to discuss such a simple problem at length, but it appears to me to be desirable that the matter should be settled once and for all, and any improvement on my method will doubtless be of interest to others besides. M. E.

Manchester, England.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(50) Reader, Boston, asks: What effect would water have on a boiler in a sinking boat, the boiler being at the time under working pressure? Could the submerging of a boiler under steam cause an explosion? A.—So far as we know the submergence of a boiler under water while at full pressure could not cause an explosion, but on the contrary would be very likely to prevent an explosion which might otherwise occur. Your other question can best be answered by those who deal in the metal you name.

(51) W. T. S., Harrisburg, Pa., asks: In a compressed air plant where it is advisable to cool the air, or, rather, allow it to cool, as much as possible before conveying it to the machines, is there any gain in using a receiver 3 feet diameter by 10 feet long, vertical instead of horizontal, the air being taken from the bottom in either case? A.—It is better to have the receiver vertical, admitting the air at the top and taking it out about 2 feet from the bottom of the receiver. The air will not cool as rapidly in the receiver as it will in the pipes, and if it could traverse pipe enough to become thoroughly cooled before going into the receiver, then more water would be deposited in the receiver, or the air would be drier, and less likely to "freeze up" in working.

(52) K. T. J., Utica, N. Y., asks: With an engine of given dimensions. If I add 1 inch to the diameter of the cylinder, do I increase the power of the engine the same as I would to add 2 inches to the length of the crank? What is the relative proportion between the increase of travel and increase of cylinder diameter? A.—With the same mean effective pressure per stroke, and the same number of rotations per minute the power will increase directly as the length of the stroke, or directly as the square of the diameter, so that these two particulars can have no constant relation to each other. With an engine with a cylinder 24x24 inches, if the stroke was increased 2 inches the increase of power would be nearly the same as if the diameter of the cylinder was increased 1 inch. The arithmetical statement would be like this: $24 : 26 : : 24^2 : 624$, and then the diameter for the cylinder which, with the original stroke, would give the same power would be $\sqrt{624} = 24.98''$. If, however, the engine cylinder was 24x48 inches it would only be necessary to increase the cylinder diameter ½ inch to equal an increase of 2 inches in length of stroke. The statement in the latter case would be: $48 : 50 : : 24^2 : 600$, and then $\sqrt{600} = 24.49''$.

Convention of the American Foundrymen's Association.

The fourth annual convention of the American Foundrymen's Association will be held at the Monongahela House, Pittsburgh, May 16 to 19, 1899. Tuesday morning, May 16, will be devoted to the regular business of the convention, prefaced by reports of the officers. The committee appointed at the last meeting, held in Cincinnati, Ohio, to establish and supply an agency for standardized drillings will then make its report. The committee consists of Thomas D. West, chairman; Dr. R. G. G. Moldenke, James Scott, P. W. Gates, E. H. Putnam, and they have been actively at work for the entire year investigating and experimenting on a large scale and preparing a report which, it is confidently expected, will be of great interest, and which will be followed by discussion.

The convention will reassemble at 8 P. M., and listen to two papers illustrated with stereopticon views: "A New England Foundry," by Mr. A. W. Walker, illustrating the new works of the Walker-Pratt Manufacturing Company, at Boston, Mass., and a paper by Mr. W. J. Keep, entitled "Original Methods of Handling Materials at the Works of the Michigan Stove Company, Detroit, Mich."

At the Wednesday morning session, May 17, the following papers will be read: "The Utility of Chemically Standardized Iron Samples," by Albert W. Smith; "The History and Technique of Brass Founding," by James Powell; and "The Importance of Fillets and Round Corners in Modern Machinery Castings," by John M. Richardson. Evening Session.—An informal reception will be tendered those in attendance upon the convention, and their friends, at the Hotel Schenley, to which the ladies are especially invited. Thursday, May 18, the following papers will be read: "The Advantages of an Upper Floor Foundry for Light Castings," by C J. Wolff; "An Improved Method for Setting Up Brass Furnaces," by Eli Millett; and "The Deceptive Fracture of Pig Iron," by Thomas D. West.

It is expected that discussion will follow all the papers presented.

Thursday afternoon the members of the convention and their friends will go via steamboat to Homestead, Pa., where a full opportunity will be given them to inspect the famous Homestead plant of the Carnegie Steel Company. Thursday evening a smoker will be tendered those in attendance at the convention, at the Monongahela House. Friday, May 19, will be given up to a general entertainment of all visitors and every opportunity and assistance will be given to those desiring it to visit local foundries and points of interest. A committee of ladies has been appointed who will have every arrangement completed for the care of ladies accompanying those who come to the convention, and who will provide entertainment throughout the entire meting.

Personal.

Mr. W. L. Breckinridge has recently been appointed chief engineer of the Chicago, Burlington & Quincy Railroad, with headquarters at Chicago.

Following recent changes in the management of the American Screw Company, of Providence, R. I., Mr. B. R. Waldron has been appointed master mechanic for the Eagle and Bay State mills. Mr. Waldron has been connected with the above company for the past twenty years,

(*Continued on page 39.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

Shafting straighteners; best made; prices reduced. J. H. Wells, Tampa, Fla.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J. L. Lucas, Prov., R.I. Send for index sheet.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

1,000 taps, standard and odd sizes, shopworn, cheap; all sizes of Tabor governors. Box 297, AMERICAN MACHINIST.

For Sale—A fully-equipped machine shop, enjoying the trade from the city and surrounding country. Address The Heer Machine Works, Alliance, O.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. (postal order) by G. W. Dixon, Spring Lake, Mich.

The Waltham Machine Works, Waltham, Mass., make a specialty of accurate work. Correspondence in regard to small automatic machinery, punches and dies, etc., is solicited.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Technical mechanical draftsman, 5 years' experience; new manufacturing plants a specialty; capable of taking charge of drawing room. Box 301, AMERICAN MACHINIST.

Change wanted, by mechanical draftsman and designer; Conn. or Mass. preferred; 10 years' experience, automatic machinery, tools and fixtures. Address Box 300, AM. MACH.

Position as foreman pattern maker; 18 years' experience in marine pumping, mining and sugar machinery; a hustler; open after June 1. Address Del Val., 523 Wyoming ave., Scranton, Pa.

Machinist with technical education and considerable experience as draftsman and foreman on machinery and tools for manufacturing purposes, wants a position. Box 293, AMERICAN MACHINIST.

First-class machinist, with 19 years' experience in rolling mill, sugar and general machine work, wants to change his position; was assistant foreman and erector in Germany, Cuba and United States. Box 274, AMERICAN MACHINIST.

Help Wanted.

Wanted—Draftsman with experience in machine-tool building, for shop near Chicago. Address Box 294, AMERICAN MACHINIST.

Draftsman, accustomed to printing-press work and designing new machinery. Address, stating experience and salary expected, Box 295, AMERICAN MACHINIST.

Wanted—Experienced draftsman on steam-pump and air-compressor work, also assistant foreman over machine tools; located in Ohio. Box 298, AMERICAN MACHINIST.

Boiler maker, a man to lay out work and assist foreman; must be sober and industrious; a good job to a suitable man. Address Box 302, AMERICAN MACHINIST.

Wanted—Superintendent of machine shop, to take charge of about 75 men; should understand reading drawings and drafting. Address Box 296, AMERICAN MACHINIST.

Wanted—A first-class, all-round machinist and pattern maker to buy a part interest in a well-established foundry and machine shop in the West. Address Box 289, AM. MACH.

A good machine-shop foreman with some money can have a leading position and interest in a new shop, on high-grade work. Address Secy. of Commercial Club, Birmingham, Ala.

Wanted—Foreman or assistant superintendent familiar with the construction of gasoline engines. Reply at once to Box 302, Toronto Junction, Ontario, stating experience and salary.

Wanted—A young man with some technical engineering experience, to travel and sell hydraulic machinery; state age, experience salary expected and give references. Box 292, AMERICAN MACHINIST.

Wanted—Five or six good machinists and two good molders and one blacksmith, to increase our force, in machine shop building hoisting and haulage engines for coal mines. In applying give full particulars as to experience and age to Kenney & Co., Scottdale, Pa.

Wanted—A first-class head draftsman who has had thorough technical education and shop experience; our work is mainly Corliss engine work, but prefer man with ice-machine experience; position open now; state experience; give references. Address Box 267, AMERICAN MACHINIST.

Wanted—Foreman for the brass department of a manufacturing establishment, having charge of 20 to 25 men; must be thoroughly up to date in the best practices, understand the making of tools, etc.; state age, experience and salary expected. Box 291, AMERICAN MACHINIST.

Wanted—A young or middle-aged man of good habits, familiar with modern methods of machine practice, to take charge of machine work in a shop devoted to building shapers, located in an Ohio town; state experience and salary expected. Address Box 271, AMERICAN MACHINIST.

We desire, for our press and special machinery department, a thoroughly reliable and practical foreman; same must know how to handle work and men to advantage; preference will be given to experienced men; state, age, reference and wages expected. Box 299, AMERICAN MACHINIST.

Apprentices—A few additional apprentices, 16 to 17 years old, will be received by R. Hoe & Co., printing press manufacturers, to learn the machinist's trade in its various branches; attendance at the firm's school three evenings each week is expected. Apply personally at 9 o'clock, or by letter, R. Hoe & Co., 504 Grand st.

Draftsman, hydraulic and mechanical, able to design and execute well-finished drawings, thoroughly posted in details of modern water-wheel construction and development of water powers; permanent position for a suitable man; give references and state salary. Address The Wm. Kennedy & Sons, Limited, Owen Sound, Canada.

Wanted—Two or three young men of fair education (technical preferred) to work under instructions in machine shop, to whom a good chance to learn would be given; mechanical drawing taught winters; 2 or 3 years' experience required to start; work mostly building automatic machinery. Box 290, AMERICAN MACHINIST.

Situation as assistant superintendent for Swedish cycle factory, open for a thoroughly good and all-round experienced man, well up in everything concerning up-to-date manufacturing of bicycles, and capable of taking up momentary position as foreman in any of the departments, if required. Applications, stating age, experience, references and salary expected, Box 303, AMERICAN MACHINIST.

Wanted—Young man of technical education who has had experience in superintending power plant and repair shops of large manufacturing establishment; must have good executive ability and be able to handle men; experience on experimental machinery also desirable. Address, giving references, experience and salary expected, Kodak Park Works, Eastman Kodak Company, Rochester, N. Y.

NO RISK.

A small part of your spending money invested in an education will pay big dividends. You can obtain an education which will qualify you for a better position and higher pay if you will devote some of your spare time at home to study at a cost so low that you will not feel the outlay. Courses by mail in

Mechanical, Steam and Electrical Engineering, Mechanical Drawing and Machine Design. Best Text Books and Drawing Plates Free.

Seven years of experience in teaching by correspondence. Write for our illustrated Circular T, sample pages of text books, drawing plate and booklet of letters from students all over the world.

The United Correspondence Schools,

154, 156, 158 Fifth Ave., New York.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 150 gals. per day. Used in 23 countries. Testimonials from the leading firms in every field of industry.

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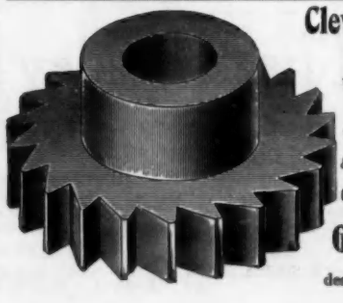
AKRON, OHIO, U.S.A.

Business Established 9 Years.

Largest Manufacturers of Oil Filters in the World.



Cleveland Gear Works

W. R. SAWYER, Lessee.

86 Seneca St.,

Cleveland, Ohio.

GEARS of all descriptions.

(*Continued from page 38.*)

during the latter ten of which he has had charge of the experimental department.

Mr. E. Sanderson, who has been representing the C & C Electric Company, of New York, in St. Louis, Mo., has been appointed manager of the new Chicago office of the company referred to, which it is their intention to open as soon as a suitable location can be secured.

Obituary.

Thomas Wood, the founder, with his brother, of the Fairmount Machine Works, Philadelphia, died in that city April 30; eighty-five years old. Mr. Wood was a native of England; came to the United States in 1830; started the business above named in 1839, and retired in 1888.

Lucius M. Pitkin, president of the Variety Iron Works, Cleveland, Ohio, was killed by a railroad train April 29. Mr. Pitkin was seventy-four years old. He organized the Cleveland Malleable Iron Company in 1868, and had been president of the Variety Iron Works from the organization of the company.

Benjamin Eastwood, president of the Eastwood Machine Works, Paterson, N. J., died in that city April 26; sixty years old. Mr. Eastwood came to this country from England in 1863. He founded the machine business which bore his name a few years later. His specialty for many years was laundry machinery.

Captain Alfred E. Hunt, president of the Pittsburgh Reduction Company, died in Philadelphia, April 26; forty-four years old. He was born in East Douglass, Mass., and was educated at the Boston High School and the Massachusetts Institute of Technology, from which he graduated in 1876. He was then employed with the Government geographical survey in the West, and later was connected with the Bay State Iron Works, in South Boston, and the open hearth steel works in Nashua, N H. Captain Hunt went to Pittsburgh in 1879, first with the Black Diamond Steel Works. In 1882 he, with George H. Clapp, established the Pittsburgh Testing Laboratory. In 1888 he organized the Pittsburgh Reduction Company for the production of aluminum. Captain Hunt was commander of the famous "Hampton Battery B" of the National Guard of Pennsylvania. He volunteered into the national service, and while at Porto Rico he was attacked by malaria, from the effects of which he never recovered, and his death was clearly caused by his war service. He was a member of the American Society of Civil Engineers, American Institute of Mining Engineers, American Chemical Society, Institution of Civil Engineers of Great Britain, Iron and Steel Institute of Great Britain, and many others. The Norman gold medal was awarded to him by the first named society

for his paper, read at the World's Fair Engineering Congress, entitled "A Proposed Method of Testing Structural Steel."

Too Automatic.

At least two separate stories have been started on their wanderings through our exchanges which make automatic car couplings to be also at times automatic uncouplers and then automatic recouplers. It is told with considerable circumstance and detail that on the Panhandle railway, and also on the Chicago & Alton, a box car in the middle of a train jumped the track when the train was running forty miles an hour. The car in each case slid out entirely free from the rest of the train, which recoupled itself and went on as though nothing had happened.

Inquiry for Machinery.

(103) For name and address of manufacturer of a compound known as "steel cement," which is used for filling defects in castings.

Technical Publication.

"The Steam Engine Indicator," compiled from the regular issues of "Power," 208 6x9-inch pages, with 147 illustrations. The Power Publishing Company. Price, $1.50.

We would hardly have believed it possible at this date that so fresh and useful a book on the indicator could be written as this one proves to be. The ground is, of course, well trodden, but the book is in no sense a rehash of old material. On the contrary, fresh live matter will be found in every chapter. The treatment is unusually thorough, without being labored or cumbersome, and such subjects as the use of the planimeter, the action of steam in the cylinder, indicating compound engines, and combining the diagrams from such engines furnish instruction not usually supplied by books on the indicator. Several tables, not elsewhere published, greatly abridge the actual performance of work of this kind. The book can be unreservedly recommended, and the ambitious young student of the steam engine will find it to give him an excellent start on the desired road. With so much that is good it is almost ungracious to point out deficiencies, but we confess that we could have wished to see more attention paid to the unusual types of indicators which are more common abroad than here, and some of which possess decided merit; to the indicating of pumps and air compressors; and to extremely high-pressure work.

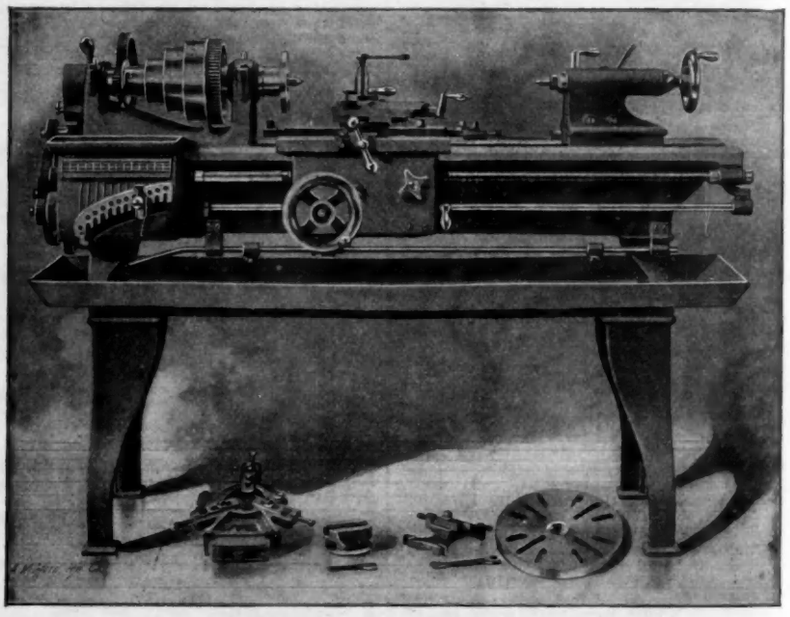
The office of the secretary of the American Institute of Mining Engineers has been removed from 13 Burling Slip to the Phelps-Dodge Building, 99 John street, this city.

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 468,183, 470,591, 519,294, 549,006 and 557,031, granted to P. & W. Schellenbach, W. P. Norton, and W. L. Schellenbach, for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

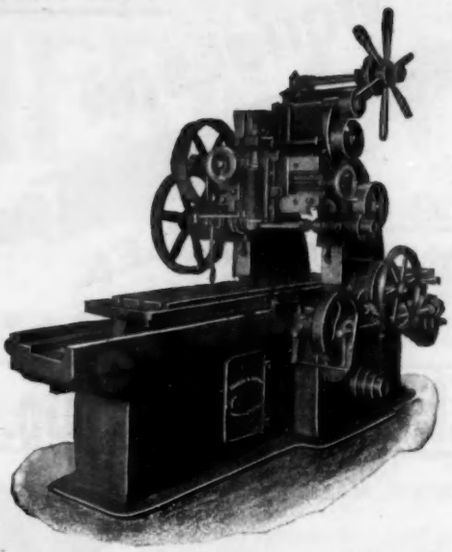
TORRINGTON, CONN.

UNITED STATES AGENTS:

Hill, Clarke & Co., Boston. Manning, Maxwell & Moore and The Garvin Machine Co., New York. J. W. Cregar, Philadelphia. U. Baird Machinery Co., Pittsburgh. The E. A. Kinsey Co., Cincinnati. Manning, Maxwell & Moore, Chicago. Pacific Tool & Supply Co., San Francisco.

EUROPEAN AGENTS:

Schuchardt & Schütte, Berlin, Vienna, Brussels, Stockholm. Chas. Churchill & Co., London and Birmingham, England. Adolphe Janssens, Paris, France.



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A STRONG, SUBSTANTIAL TOOL, EMBODYING ALL MOST RECENT IMPROVEMENTS.

TABLE 14 IN. WIDE, 8 FT. LONG.

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Garvin Machine Co., Berlin.
Adphe. Janssens, Paris.

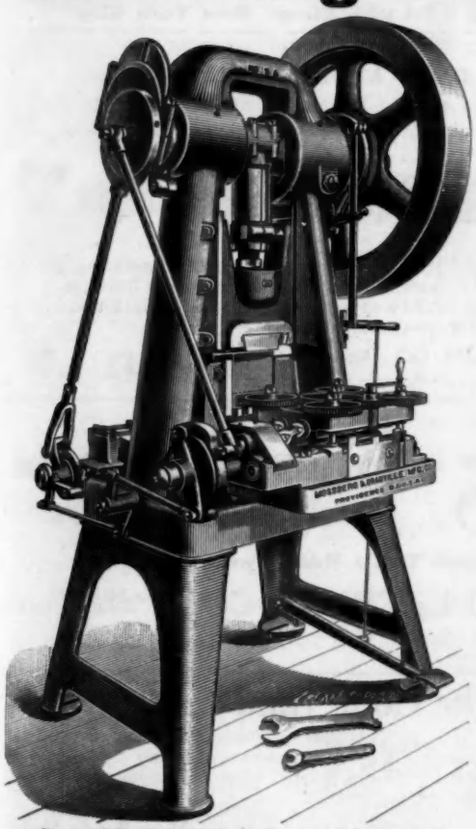
Beaman & Smith,

PROVIDENCE, R. I., U. S. A.

Makers of the above, and other regular and special Machine Tools.

Mossberg & Granville Mfg. Co.

PROVIDENCE, R. I.



No. 5. A Single Acting Power Press, with Special Feed.

Power Presses
With Automatic Feeds.

Rolling Mills
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Drop Presses,
Plain and Automatic.

Wire Drawing Machinery.

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FOREIGN AGENTS:
Charles Churchill & Co., Ltd., London, and Birmingham, England. Adolphe Janssens, Paris, France. A. Mathey Doret, La Chaux-de-Fonds, Switzerland. De Fries & Co., Dusseldorf, Berlin and Vienna.

Manufacturers.

The Mississippi Mills at Wesson, Miss., have decided to install new machinery.

S. O. Bigney & Co., of Providence, R. I., are to erect a new plant at Attleboro, Mass.

The L. D. Brown & Son Co., Middletown, Conn., has purchased additional ground on which to erect additions to its present plant.

The Cataract Optical Company contemplates the erection of a new manufacturing plant at Black Rock, N. Y., which, when completed, will cost about $60,000.

The French-Belgian Company, with a capital of $250,000, will build a modern four-story brick mill for the manufacture of fine worsted yarns in Woonsocket, R. I.

B. F. Sweeten & Son will erect a four-story addition, 30 by 136, to the building of the Camden Curtain & Embroidery Company, at Front and Pearl streets, Camden, N. J.

The Springfield Machine Tool Company, Springfield, O., contemplates the erection of additions to its plant in order to be better able to take care of orders now on hand.

At Bellefonte, Pa., it is reported that a new silk mill will be erected by a Paterson (N. J.) concern. Architect M. B. Ritter, of Williamsport, Pa., has some connection with the construction of this new mill.

A permit has been issued to the Seamless Rubber Company to erect a new factory building on Daggett street, New Haven, Conn., which will be three and four stories high. The new structure will cost $10,000. Sperry & Treat are the builders.

The Munsell Rollo stove works, at Fulton and Second streets, Elizabeth, N. J., which have been idle for several years, have been leased to some manufacturers, who will reopen the plant soon. Just what the new company will manufacture has not been given out.

The D. W. Williamson Veneer Company will erect a branch factory at Highlandtown, Md. The Williamson concern has works in Indianapolis and the firm proposes to erect a brick factory, 80 by 100 feet, at the Highlandtown location, which will contain a complete up-to-date plant of machinery for the sawing and cutting of veneers from imported and native hard woods.

The Hendey Machine Company, of Torrington, Conn., is building a new engine room, 40 feet wide and 60 feet long. The side walls are of brick; the roof has steel trusses with corrugated iron covering, supported on steel purlins. A large ventilator extends along the ridge of the roof. The Berlin Iron Bridge Company, East Berlin, Conn., furnishes and erects the steel framework and covering.

Henry Brauns, architect, has completed plans for the erection of the plant of the Birmingham Cement Company, which is to be erected at Ensley, near Birmingham, Ala. The buildings will include slag crush mills, storage warehouses, compounding houses, boiler, engine and dynamo houses. They will cost about $75,000, and will be built of stone, brick frame and corrugated iron.

The work of building the additions to the factory of Andrew Jergens & Co., Cincinnati, is well under way. The new building will be 5 by 125 feet and will be occupied by machinery used in the manufacture of the toilet soaps of the company's make. The addition will make a plant about 400 feet in length on Alfred street, the new part making no increase of the Spring Grove avenue side.

A proposition is on foot to construct an electric railroad to connect Streator, Grand Ridge, Ottawa, Utica, La Salle and Peru, in the State of Illinois. The total length of the line will be 30½ miles. Naugle, Holcomb & Co., of Chicago, Ill., are to build the road. Messrs. Reeves & Boyes have secured the

right of way through the cities on the route, excepting a short distance between Utica and La Salle.

The Pneumatic Supply & Equipment Company has been organized under the laws of the State of New York, and has opened an office at 120 Liberty street, New York. It is the purpose of this company to deal generally in compressed-air equipment, and it will make a specialty of the installation of complete plants. Mr. J. W. Duntley, the president of the Chicago Pneumatic Tool Company, is the president of the new company. Mr. E. B. Gallaher, formerly with Messrs. Patterson, Gottfried & Hunter, is the vice-president and engineer, and Mr. W. P. Pressinger, formerly manager of the Clayton Air-Compressor Works, is secretary and treasurer.

New Catalogs.

We have received from Richard Melhuish & Sons, London, England, a copy of their catalog of metal workers' tools and appliances. The tools described cover a wide field of application, including presses, drilling machines, accessories for precision work, molders' tools, etc., etc. The catalog also contains a number of hints likely to be found useful in the workshop. The prices of the various tools are given. The catalog contains 305 pages and is neatly bound. It is 8¼ x 10¾ inches.

Chas. H. Besly & Co., Chicago, have issued a new catalog of tools and supplies for machinists, molders, pattern makers, draftsmen, etc., etc. Prices of the various tools are given, and the catalog abounds with illustrations. In addition to the purely business matter contained in the catalog, there are a number of tables which should prove serviceable to mechanics. These include tables of equivalents of metric weights and measures, speed of drills, weight of brass and copper and zinc tubing, wire, also sheet copper, and many others. The catalog is bound in cloth, and a copy will be sent free, post paid, to those interested, on application. It contains 300 pages and measures 4½x8¾ inches.

The Springfield Machine Tool Company, Springfield, Ohio, has sent us 1899 catalog of turret lathes, power presses, shaping machines, etc., and on page 18 of which is illustrated and described a new type of lathe embodying the features of a turret lathe with those of an engine lathe. This is accomplished by means of a turret which can be placed upon the bed, and which interchanges with the tail stock when the same lathe is to be used for turning work between centers, or held in chuck or face-plate. The turret slides are supplied with variable power feeds and automatic stops, which in no way interfere with the usual engine lathe feeds, each being independent of the other. The catalog is standard size, 6x9 inches.

The Unbreakable Pulley & Mill Gearing Company, of West Gorton, Manchester, England, has sent us copy of catalog and treatise on the "Economical Transmission of Power." The catalog gives, in very complete detail, methods to be followed in the choice of line shafting and the general arrangement of the same, describes the relative advantages of different methods for transmitting power by toothed gearing, belts and ropes, also information as to how to go about the erection of shafting. To those interested in the fitting up of machine shops and factories where line shafting is to be used, the catalog ought to be of great interest. The various products of the company referred to are described and illustrated. The book is nicely bound and contains 157 5¼x8¼-inch pages.

76,800 DAILY PRODUCTION
5 FACTORIES
5 BRANDS
16 Governments
85% R.R., 70% U.S. Contracts
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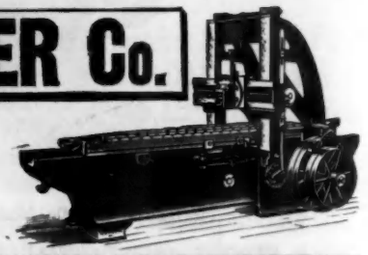
Robinson & Cary Co., St. Paul, Minn.
W. K. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.


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WHEN YOU ARE TOLD THAT JENKINS' '96 IS MORE EXPENSIVE THAN OTHER PACKINGS.
Average weight ⅛ inch "Jenkins '96," 11 lbs. to the square yard.
" " ⅛ " Red Packing, 14 " " " "
At 50c. per pound "JENKINS' 96" is not only very much cheaper, but the best joint packing manufactured.
JENKINS BROS. NEW YORK, BOSTON, PHILADELPHIA, CHICAGO.

STEAM BOILER PRACTICE IN ITS RELATION TO FUELS AND THEIR COMBUSTION
AND THE ECONOMIC RESULTS OBTAINED WITH VARIOUS METHODS AND DEVICES.
By WALTER B. SNOW, S.B., Member American Society of Mechanical Engineers. First Edition. First thousand.
x + 297 pages; 24 figures. 8vo. Cloth, $3.00. *Order through your bookseller; or copies will be forwarded, postpaid, by the publishers, on the receipt of the retail price.*
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The surface of some makes of emery wheels when exposed to moist air becomes soft and gummy.
CARBORUNDUM
wheels are rendered moisture proof by the vitrifying process of cementing or binding the material into shape. Carborundum is the best abrasive because it works faster, it works better, and it takes less to accomplish the desired result.
Beware of a substance called Emery-Carborundum.
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TOOLS A Large Asssortment of Regular and Special Tools for Machinists.
If you want "The Best That's Made," write us.
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The "Card" Kind is the Good Kind
whether it is in Taps, Dies, Screw Plates or any of the other things that Card makes, and Card's prices are as low as the prices of the "just as good" kinds. Get the "Brown Book," have it handy, and when it comes to writing an order, specify "Card's."
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